APPENDIX D

HYDRODYNAMIC MODEL RESULTS

HYDRODYNAMIC MODELING

The hydrodynamic evaluation of Bogue Inlet was performed using the Advanced Three-Dimensional Circulation Model for Shelves, Coasts, and Estuaries (ADCIRC, Luettich, et al., 1992). The version used for Bogue Inlet is a two-dimensional, depth-averaged model able to simulate the wetting and drying of shallow tidal flats. Inputs to the model include bathymetry, shorelines, friction factors, and lateral viscosity.

Bathymetric Data

Bathymetric data for the seaward portion of Bogue Inlet was collected by Coastal Science and Engineering (2001) between September and October 2001. The data covered the area bounded by Dudley Island to the north, the Atlantic Ocean to the south, Bear Island to the west, and Emerald Isle to the east. The CSE (2001) data also included a survey of the main inlet channel between the northwest edge of Emerald Isle and the Intracoastal Waterway (ICWW).

Additional soundings were collected in 2002 by the U.S. Army Corps of Engineers, Wilmington District (2002). These soundings covered the ICWW between Topsail Beach and Bogue Inlet. They also included the main channel of Bogue Inlet between the Atlantic Ocean and the ICWW.

To supplement this data, soundings were taken from National Ocean Service (2001) Nautical Chart 11541. These soundings included Bogue Sound, the southern end of the White Oak basin, and the southern end of the Queen's Creek basin. Where no soundings were shown inside the White Oak and Queen's Creek basins, a depth of -2 feet below MLLW (-3.8 feet NGVD) was assumed. This depth was based on the limited number of soundings shown for these areas. Where no soundings were shown inside the Bogue Sound, a depth of 0 feet below MLLW (-1.8 feet NGVD) was assumed. This depth was based on the numerous tidal flats inside the sound and the 1993 USGS aerials (2002).

The fourth bathymetry source was the National Geophysical Data Center's (2002a) Digital Terrain Model of the Atlantic coastal shelf and the continental U.S. This data was used to extend the ADCIRC model into deep water (~45 feet).

Shoreline Data

Boundary conditions for the model consisted of a seaward boundary, a "mainland" shoreline, and a number of islands. Near the White Oak basin, the Queen's Creek basin, and Bogue Sound, mainland shorelines were traced from the georeferenced 1993 aerials (USGS, 2002). Near the seaward portion of the model, the "mainland" shoreline was defined as the Mean Low Water (-1.6 feet NGVD) contour to ensure stability.

Additional shoreline information was taken from NGDC (2002b) shoreline database, which provided the locations of Dudley Island, Huggins Island, the spoil island east of Huggins Island, and a fourth island near the southern end of the White Oak basin. The remaining islands were traced from the 1993 aerials (USGS, 2002).

Model Mesh

Using the shoreline and bathymetric data, a two-dimensional finite element mesh was generated for the model (Figure 1). The spacing of the mesh nodes increases with depth and with distance from the center of the inlet. This setup allows the model to remain stable. The various channel and closure dike configurations were tested by changing the elevations of individual nodes.

Calibration

Water levels and currents were measured by CSE (2001) on September 19-21, 2001 and October 16-17, 2001, at the locations appearing in Figure 2. Water levels corresponded well with the predicted tides used as forcing in the model (Figure 3).

Currents were measured with electromagnetic current meters and an acoustic Doppler current profiler (ADP). The electromagnetic current meters allowed comparisons of the current's direction and phase. The ADP measurements permitted a depth-average current estimate by measuring the current over the entire water depth. As the Bogue Inlet model was depth-averaged, the ADP measurements were better suited for comparing the magnitudes of the current. As the velocity measurements were more extensive during the later period, October 16-17, 2001 was chosen for the calibration of the model.

To calibrate ADCIRC, the parameters governing friction, energy dissipation, flow near the shoreline, wetting, and drying were assigned:

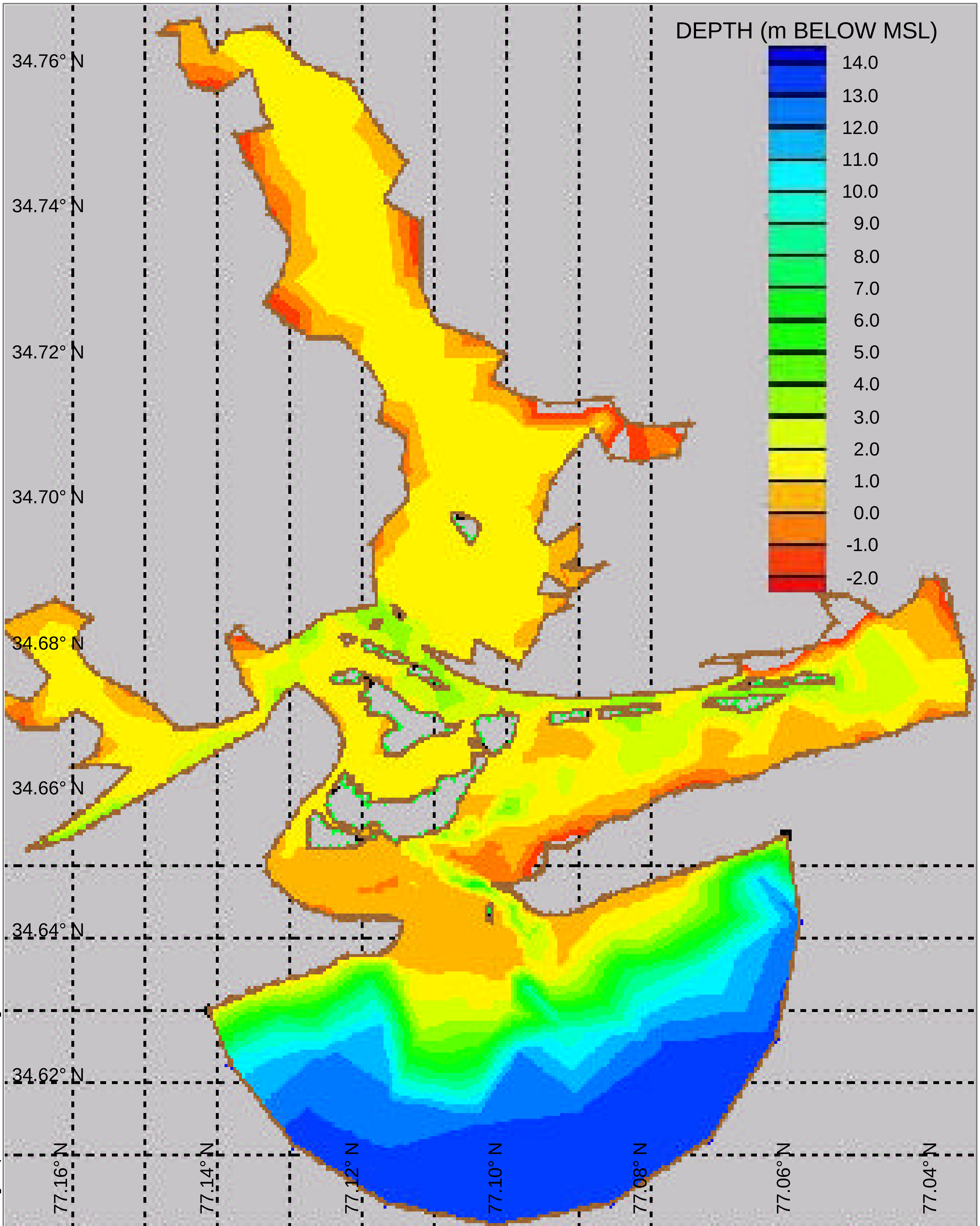
Lateral viscosity = 2.0 m^2/s (6.6 ft^2/s)
Bottom friction coefficient $C_f = 0.0025$
Wave continuity factor $\tau_o = 0.01$
Minimum angle for tangential flow = 90^o
Minimum water depth for wetting and drying = 0.05 m (0.16 feet)

The lateral viscosity governs the turbulent and viscous energy dissipation. The friction coefficient C_f and wave continuity factor govern energy dissipation by bottom friction. At Bogue Inlet, bottom friction is assumed to be proportional to

$$(C_f|\mathbf{u}|/H - \tau_o)\mathbf{u}H$$

where

C_f = bottom friction coefficient
$\mathbf{u}$ = velocity vector



COASTAL PLANNING & ENGINEERING, INC.
204 DORCHESTER PLACE
WILMINGTON, NC 28412
PH. (910) 392-0493 FAX (910) 392-0493

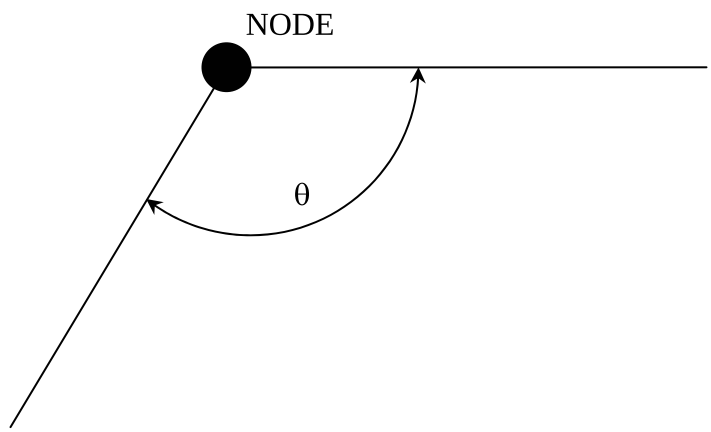
TITLE:

**ADCIRC MODEL BATHYMETRY
EXISTING CONDITIONS
BOGUE INLET, N.C.**

DATE: 11/15/02	BY: TW	COMM. NO.: 4500.00	FIGURE NO. 1

$|\mathbf{u}|$ = current speed
τ_o = wave continuity factor
H = time-dependent water depth.

The minimum angle for tangential flow determines where flow may occur along a bend in the shoreline:



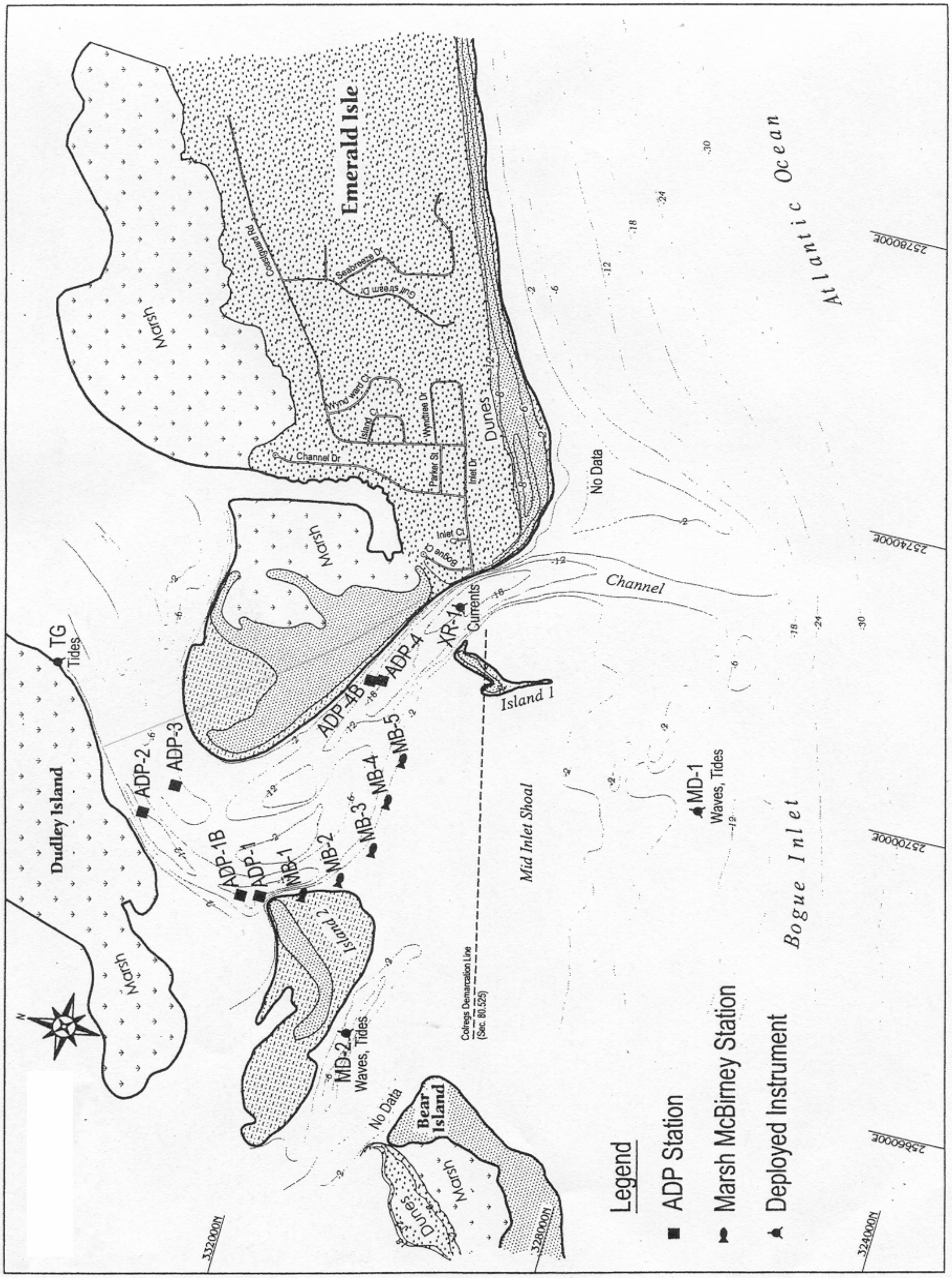
Where θ is less than the minimum angle, the velocity at the node is zero.

Comparisons of the model results to the measurements appear in Appendix A. Agreement between the observed and hindcast water levels is reasonable. Phases and tide ranges are comparable to the observations. Agreement between the observed and hindcast velocities is reasonable. Accordingly, the calibration is considered suitable for simulating the tidal flow in Bogue Inlet.

Existing Conditions

The peak flood and ebb flows given the existing conditions appear in Figure 4. The flow regime consists of a sheet flow across the mouth of the inlet, with a heavy concentration of flow near Emerald Isle. This heavy concentration of flow, which is highest during the ebb cycle, is the primary cause of the erosion near that location. Another concentration of flow occurs near Dudley Island, where the main channel switches orientation by approximately 135^o. Erosion has occurred at this location, in addition to the west end of Emerald Isle.

Extending from the northwest edge of Emerald Isle is a low sand spit. This sand spit has changed considerably over the past 50 years (CSE, 2001). Figure 4A shows that sheet flow occurs across this sand spit during the flood cycle. Sheet flow also occurs during the ebb cycle. However, during the peak ebb cycle, the flow from the sheltered area circles around the northwest end of the sand spit into the main channel.



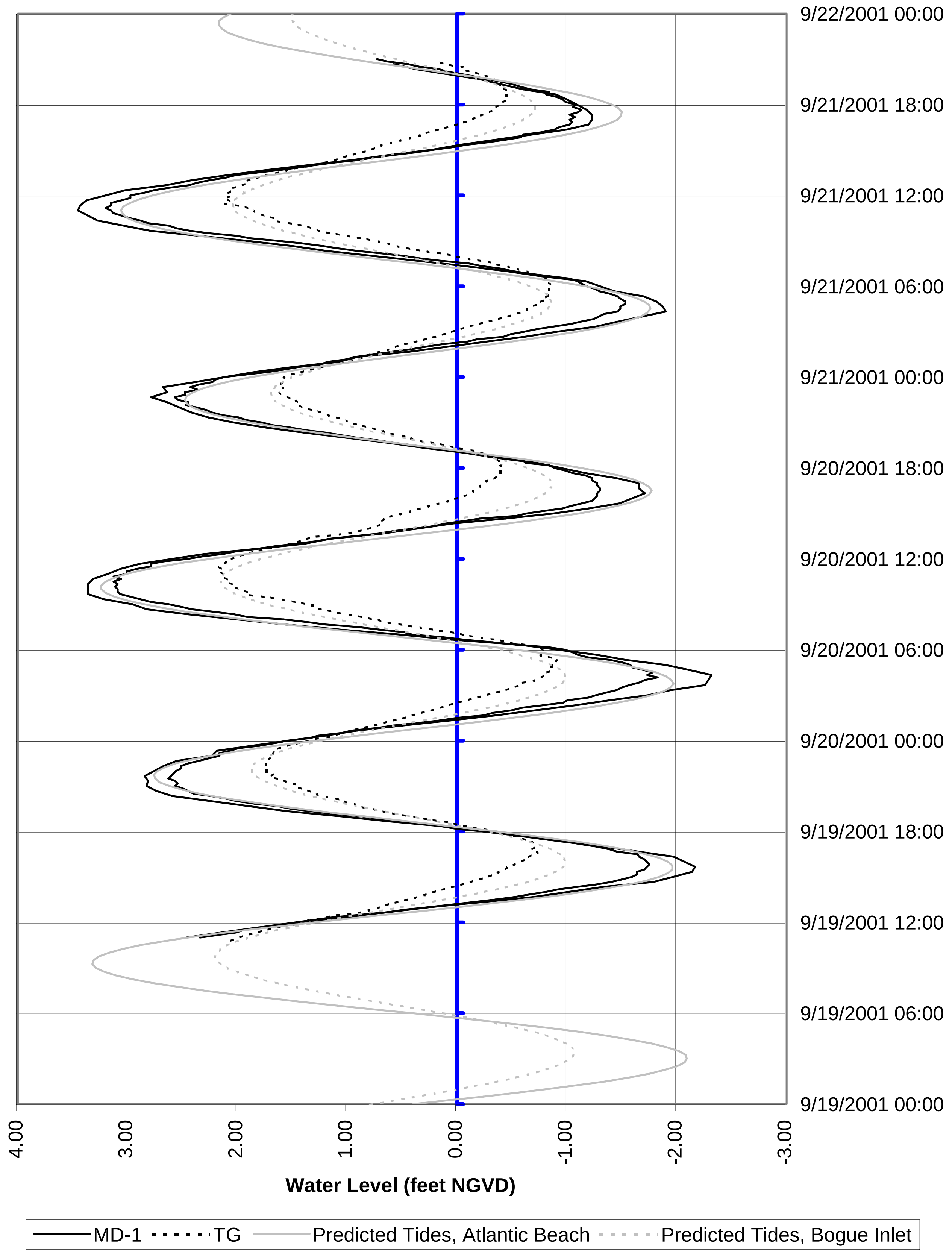
COASTAL PLANNING & ENGINEERING, INC.

2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE:

CURRENT, WAVE, AND TIDE MEASUREMENT LOCATIONS (CSE, 2001) - BOGUE INLET, NC

DATE: 12/3/2003	BY: C.DAY	COMM. NO.: 4500.00	FIGURE NO. 2



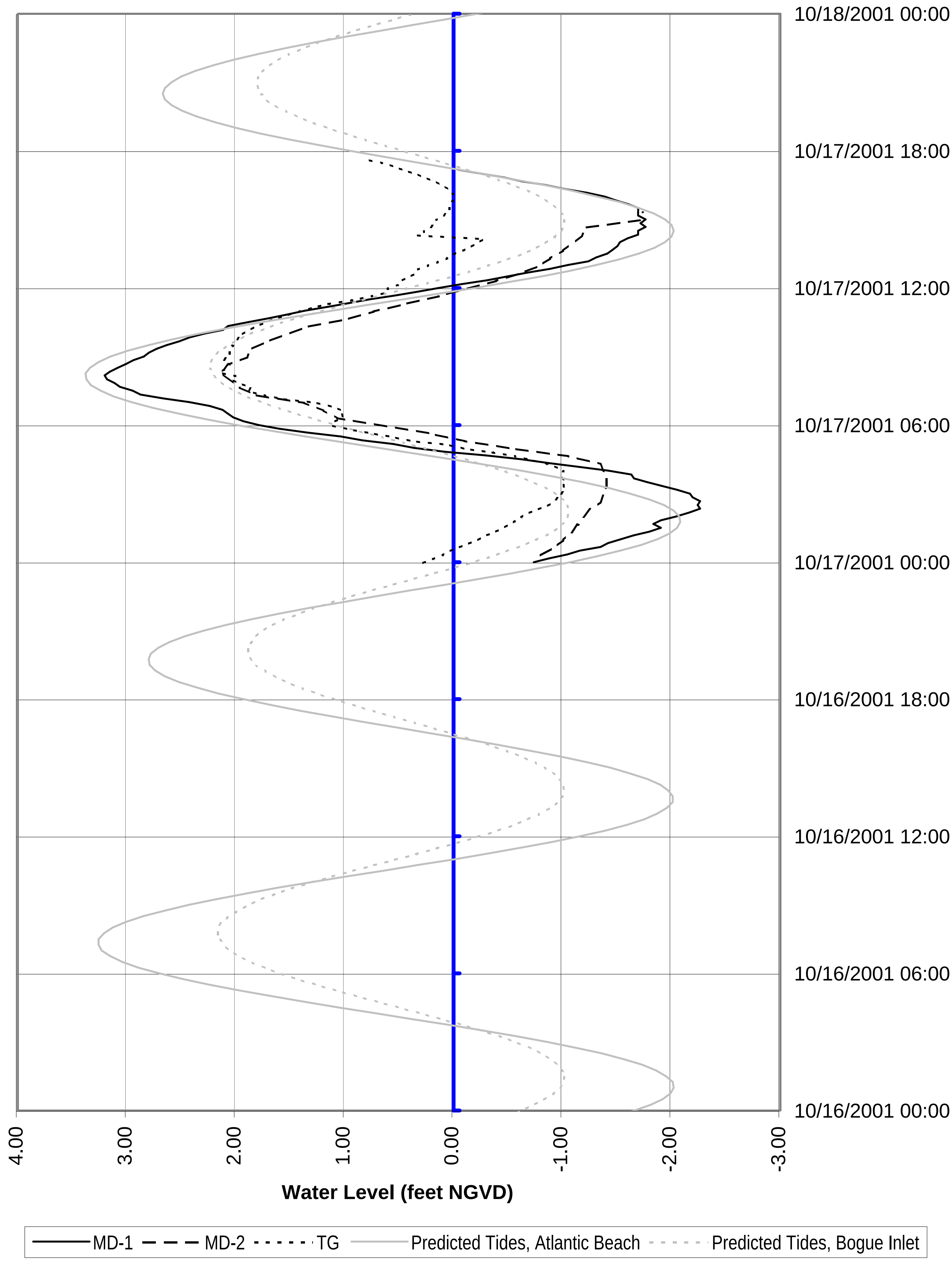
COASTAL PLANNING & ENGINEERING, INC.

2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE:

MEASURED AND PREDICTED TIDES, BOGUE INLET, NC

DATE: 12/3/2003	BY: C.DAY	COMM. NO.: 4500.00	FIGURE NO. 3A



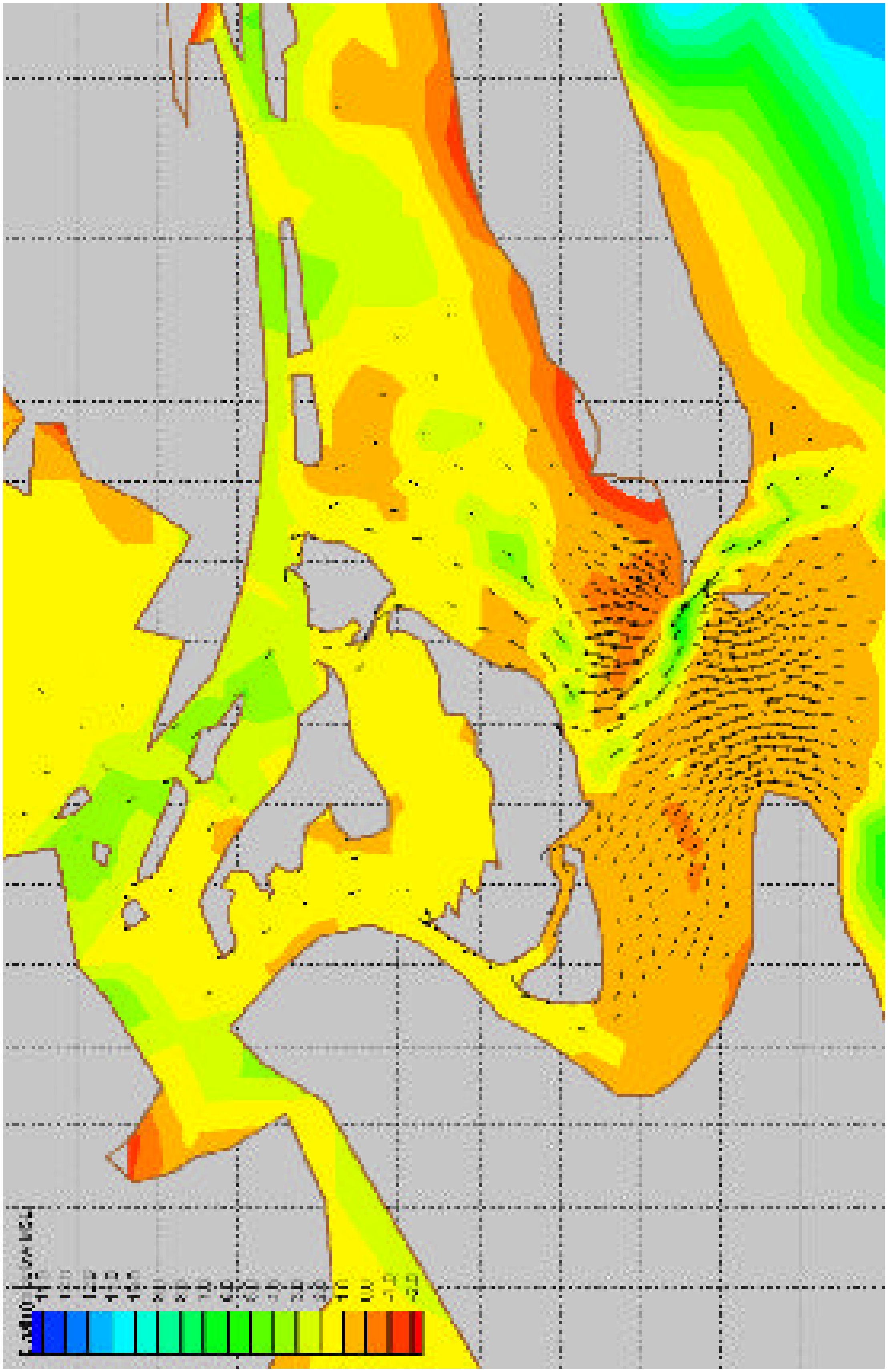
COASTAL PLANNING & ENGINEERING, INC.

2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE:

MEASURED AND PREDICTED TIDES, BOGUE INLET, NC

DATE: 12/3/2003 | BY: C.DAY | COMM. NO.: 4500.00 | FIGURE NO. 3B

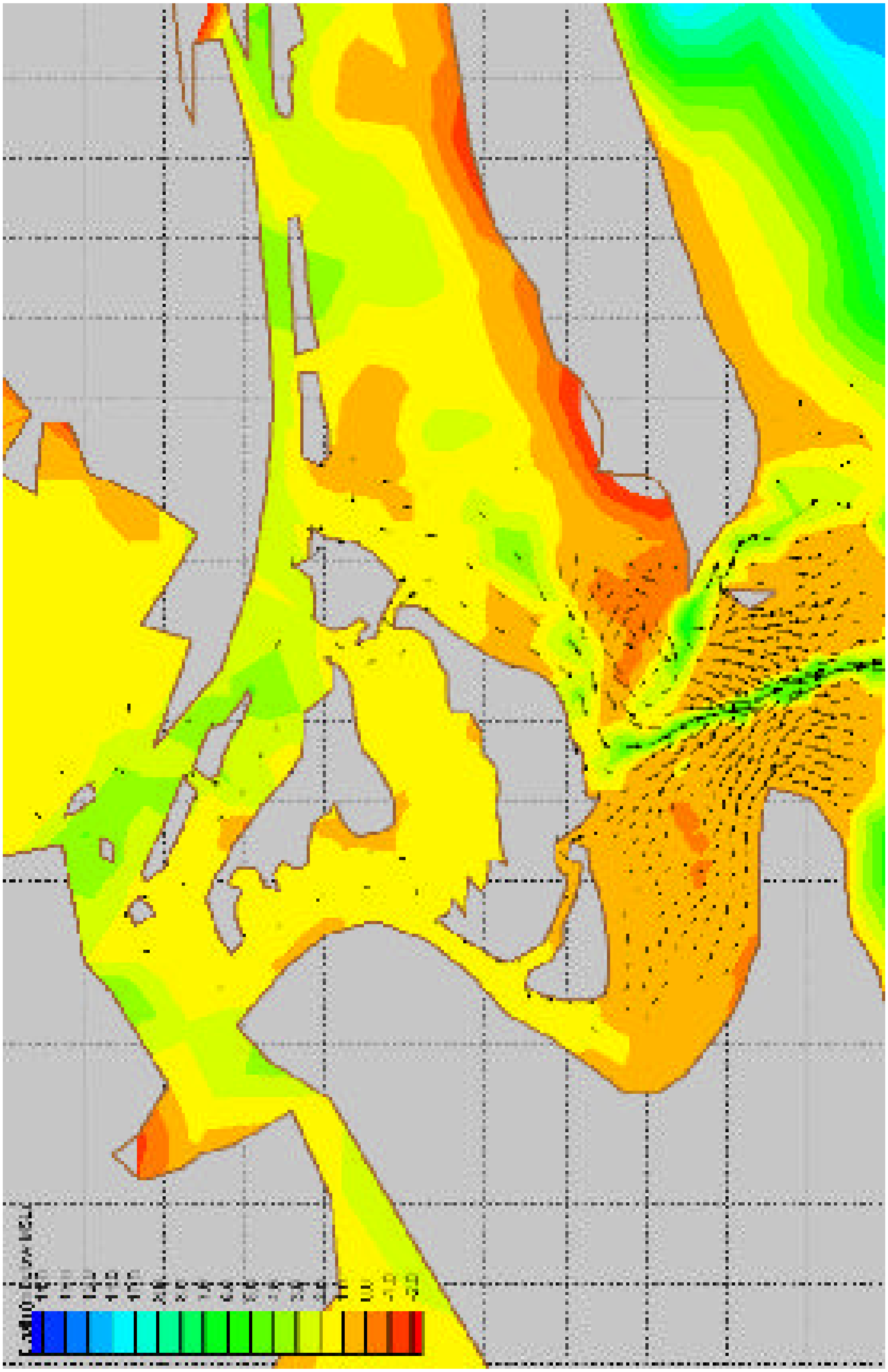


COASTAL PLANNING & ENGINEERING, INC.
2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE :

BOGUE INLET, NC
EXISTING CONDITIONS
PEAK FLOOD

DATE:	11/22/02	BY:	TW	COMM. NO.:	4500.00	FIGURE NO. 4A



COASTAL PLANNING & ENGINEERING, INC.

2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE :

BOGUE INLET, NC
EXISTING CONDITIONS
PEAK EBB

DATE: 11/22/02	BY: TW	COMM. NO.: 4500.00	FIGURE NO. 4B

To facilitate the description of the flow regime, CSE established six transects based on the bathymetry data, which appear in Figure 5. To calculate the flow across each transect, the velocity across the transect is first estimated as

$U_t = |\mathbf{u}|\ \mathrm{sign}(\mathbf{u} \cdot \mathbf{f})$

where

u = velocity vector
f = unit vector at right angles to the transect in the flood direction

The flow across the transect is then calculated as

$Q = \int U_t ds$

where

s = distance from the beginning of the transect

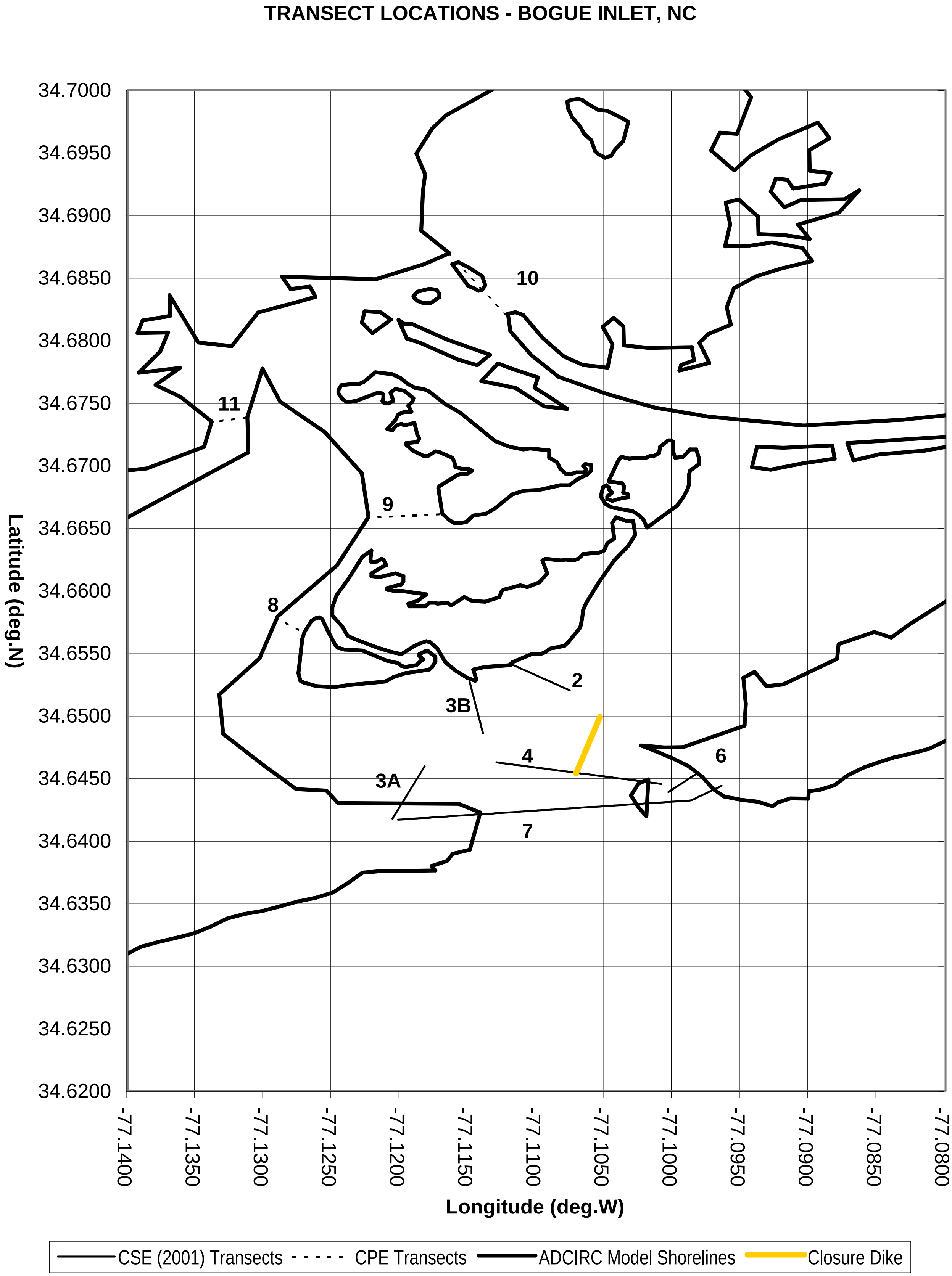
The average velocity across the transect is equal Q / A, where A is the cross sectional area of the transect. During the flood cycle, U_t and Q are positive; during the ebb cycle, U_t and Q are negative.

Velocities and discharges for the ten transects appear in Appendix B. Discharges for Transects 8 and 9 are omitted due to the lack of reliable bathymetry at these locations. Among the 10 transects in Figure 5, the most important are 2, 6, 7, and 8. Transect 7 crosses the mouth of Bogue Inlet, representing the tidal prism and combined flow into Bogue Inlet, the White Oak Basin, the Queen's Creek basin, and western Bogue Sound. Transect 6 represents the flow along Emerald Isle erosion hotspot. Transects 2 and 8 represent the flow around Dudley Island, which is a key fish and wildlife habitat.

The average modeled velocity across Transect 7 is on the order of 2 feet per second during peak flood and 2.5 feet per second during peak ebb. The corresponding discharges are roughly 40,000 cfs during peak flood and 30,000 cfs during peak ebb. The ebb flow is less than CSE's (2001) of 40,000 cfs. However, tidal prism estimates based on the ADCIRC results and CSE (2001) are similar, equal to 521,000,000 ft^3 and 535,000,000 ft^3, respectively.

The average velocity across Transect 6 is near 2 feet per second during peak flood and 3 feet per second during peak ebb. The maximum velocities during peak flood and peak ebb are 2.9 and 5.2 feet per second, respectively. The high currents are the prime cause of the erosion at this location.

The average velocity at Transect 2 is near 2.5 feet per second during peak flood and 2 to 2.5 feet per second during peak ebb. The direction of the flood current varies from north



COASTAL PLANNING & ENGINEERING, INC.
2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE:

TRANSECT LOCATIONS - BOGUE INLET, NC

DATE: 12/3/2003	BY: C.DAY	COMM. NO.: 4500.00	FIGURE NO. 5

to east-northeast. The northerly component of the velocity is responsible for the erosion along the south bank of Dudley Island. Along Transect 8, the corresponding velocities are 1 feet per second and 0.5 feet per second.

Improved Conditions

Three improved conditions were modeled: a new channel dredged to -14 feet MLW (-15.6 feet NGVD), a new channel with a +6 feet NGVD dike to close the existing channel, and a new channel with the dike partially completed. The velocities and discharges associated the first two scenarios appear in Appendix B. Although several depths are under consideration for the new inlet channel, variations in the flow patterns with small changes in design depth are expected to be minor. Accordingly, no other design depths were simulated.

-14 foot MLW Channel

The peak flood and ebb flows given a new channel dredged to -14 feet MLW appear in Figure 6. The flow regime consists of a sheet flow across the mouth of the inlet, with heavy concentrations of flow in both the new channel and the existing channel. Because flow still occurs in the existing channel, simply dredging a new channel will not be sufficient to stop the erosion of Emerald Isle. Average velocities across Transect 6 are 0.3 feet per second lower than existing conditions during peak flood and 0.5 feet per second lower during peak flood.

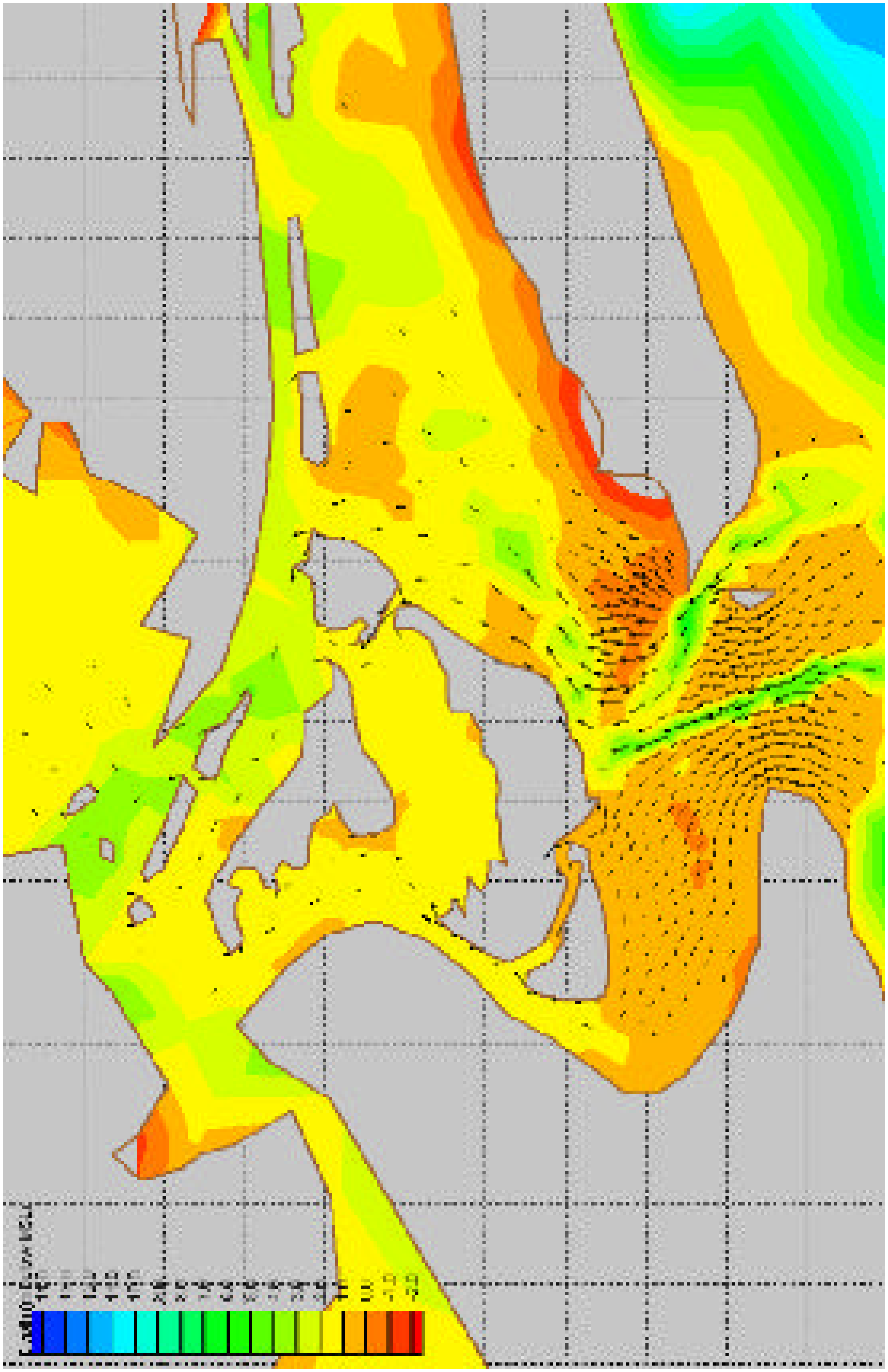
The concentration of flow near the south side of Dudley Island also remains. Average velocities across Transect 2 are 0.5 feet per second higher during peak flood and 0.7 feet per second higher during peak ebb.

Dredging a new channel while leaving the existing channel open also increases the tidal prism. Discharges through Transect 7 are 20 percent higher during flood and twice as high during ebb. However, changes in the flow regime are limited primarily to the new channel, the existing channel, and the south side of Dudley Island. In the remainder of the inlet and the adjoining basins, changes to the flow regime are negligible.

-14 foot MLW Channel with Closure Dike

To further reduce the flow in the existing channel, a +6 foot NGVD dike has been proposed to close the channel. The location of the dike is designed ensure its stability while under construction.

Preliminary simulations have shown that if sheet flow continues to occur across the Emerald Isle sand spit, strong flows in the existing channel will continue even with a dike in place. To eliminate this sheet flow, additional fill can be placed along the crest of the sand spit, raising its elevation to approximately +3 feet NGVD. The simulation appearing in Figure 7 assumes that this extra fill is in place.



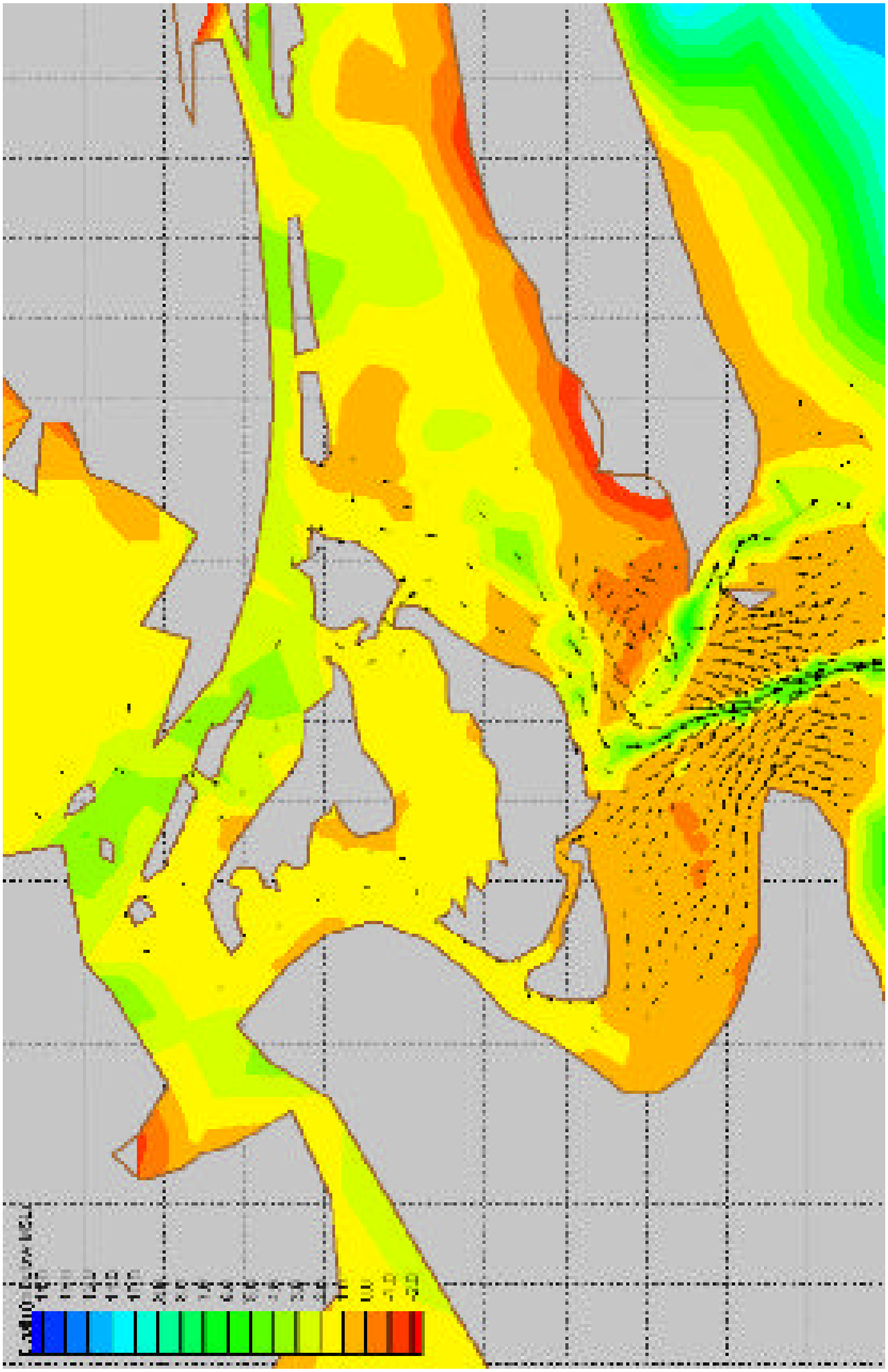
COASTAL PLANNING & ENGINEERING, INC.

2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE :

BOGUE INLET, NC
14' MLW CHANNEL
PEAK FLOOD

DATE: 11/22/02	BY: TW	COMM. NO.: 4500.00	FIGURE NO. 6A



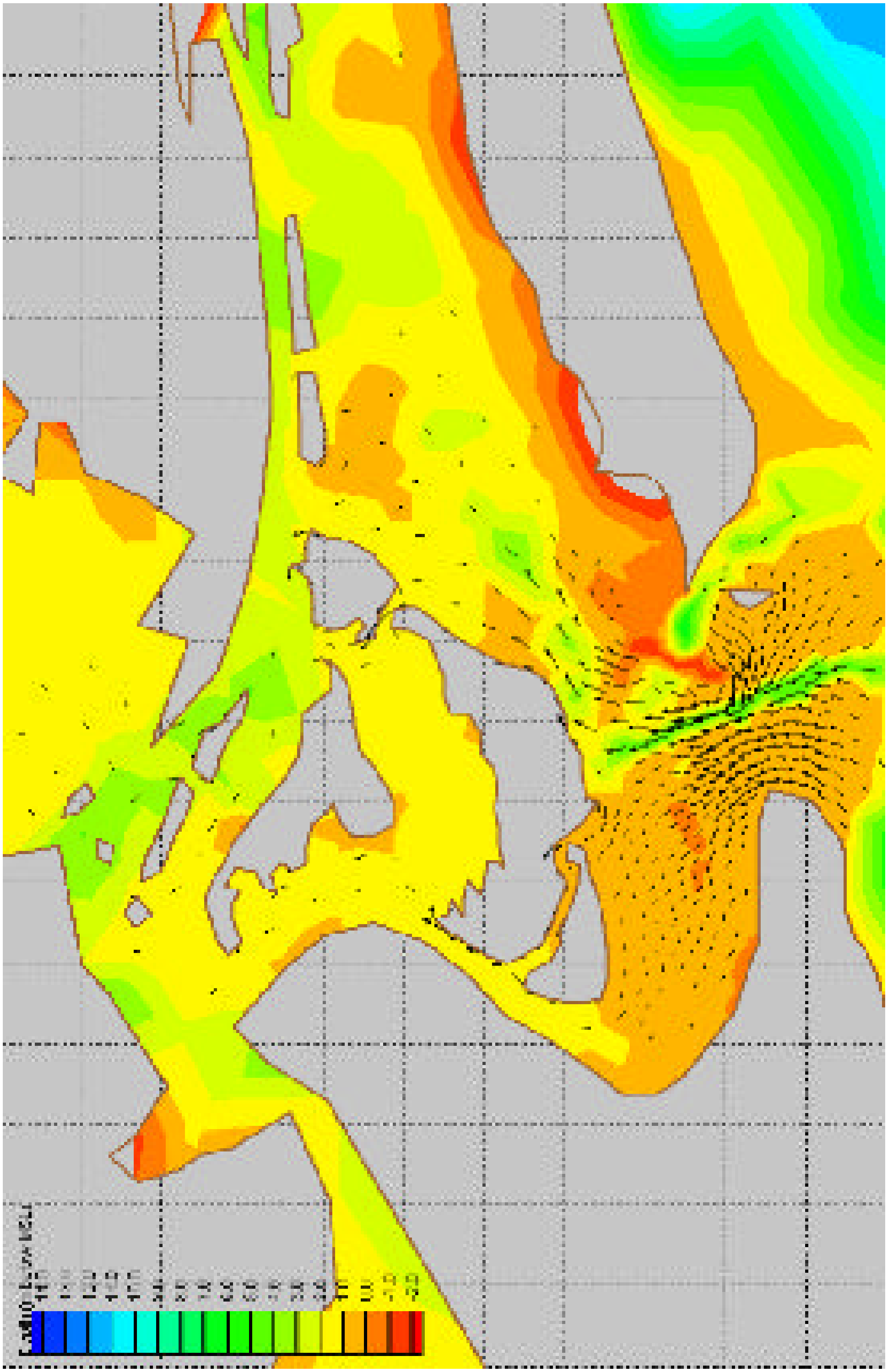
COASTAL PLANNING & ENGINEERING, INC.

2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE :

BOGUE INLET, NC
14' MLW CHANNEL
PEAK EBB

DATE: 11/22/02	BY: TW	COMM. NO.: 4500.00	FIGURE NO. 6B



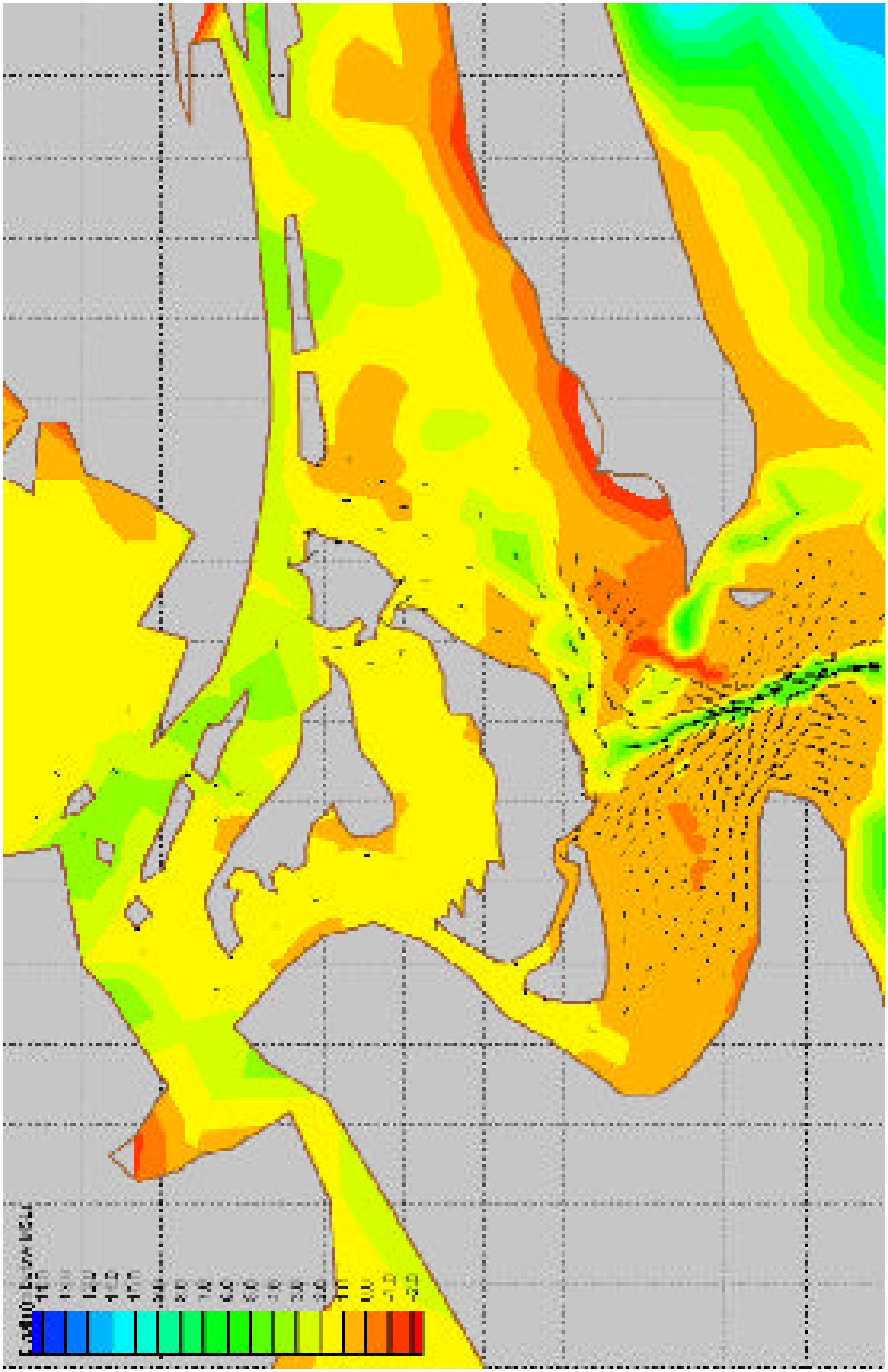
COASTAL PLANNING & ENGINEERING, INC.

2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE :

BOGUE INLET, NC
14' MLW CHANNEL WITH
CLOSURE DIKE - PEAK FLOOD

DATE: 11/22/02	BY: TW	COMM. NO.: 4500.00	FIGURE NO. 7A



COASTAL PLANNING & ENGINEERING, INC.

2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE:

BOGUE INLET, NC
14' MLW CHANNEL WITH CLOSURE DIKE - PEAK EBB

DATE: 11/22/02	BY: TW	COMM. NO.: 4500.00	FIGURE NO. 7B

With the dike and the extra fill in place, flow is concentrated in the new channel and significantly reduced in the existing channel. Along Transect 6, velocities are reduced from the existing conditions by 60 percent during peak flood and over 90 percent during peak ebb. By significantly reducing the flow through the existing channel, the dike and the new channel should be able to reduce the erosion along the west end of Emerald Isle.

Placing the dike will minimize changes to the tidal prism. Discharges through Transect 7 are much closer to the existing conditions than the scenario in which the present channel remains open.

-14 foot MLW Channel with Closure Dike

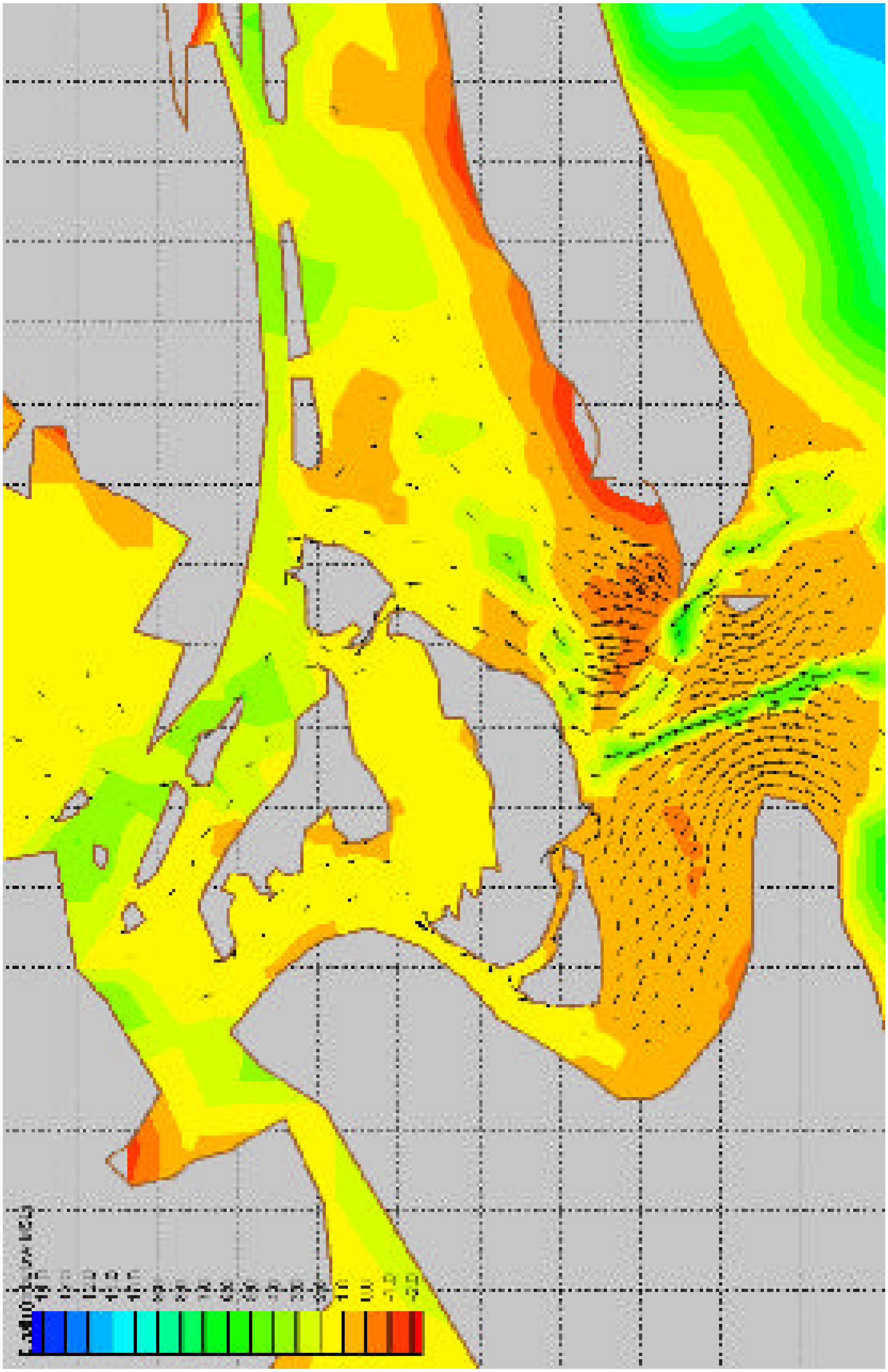
Figure 8 shows the peak flows occurring while the closure dike is midway through construction. At this phase of construction, the elevation of the dike is roughly equal to mean tide level, +0.4 feet NGVD. As Figure 6, Figure 8, and Appendix B shows, the flow patterns are similar to those expected when the dike is absent. Peak velocities at the dike location will continue at similar rates until the elevation of the dike is raised above mean higher high water. This tendency must be taken into account when planning the construction of the dike.

Conclusions

- The existing flow regime in Bogue Inlet consists of a sheet flow through the mouth of the inlet, with heavy concentration of flow adjacent to the west end of Emerald Isle. The largest currents are on the order 3 feet per second. Sheet flow also occurs across the sand spit protruding from the northwest tip of Emerald Isle. Inside the inlet, the majority of the flow circulates around the southern and eastern edges of Dudley Island, with a concentration of flow near its southern edge.

- The new channel alignment will increase flow through the center of the inlet. However, without a closure of the existing channel, there will still be a substantial concentration of flow adjacent to Emerald Isle. The concentration of flow near the southern bank of Dudley Island will remain.

- Velocities in the existing channel can be reduced sufficiently by constructing a dike to close the channel and raising the elevation of the Emerald Isle sand spit to +3 feet NGVD.



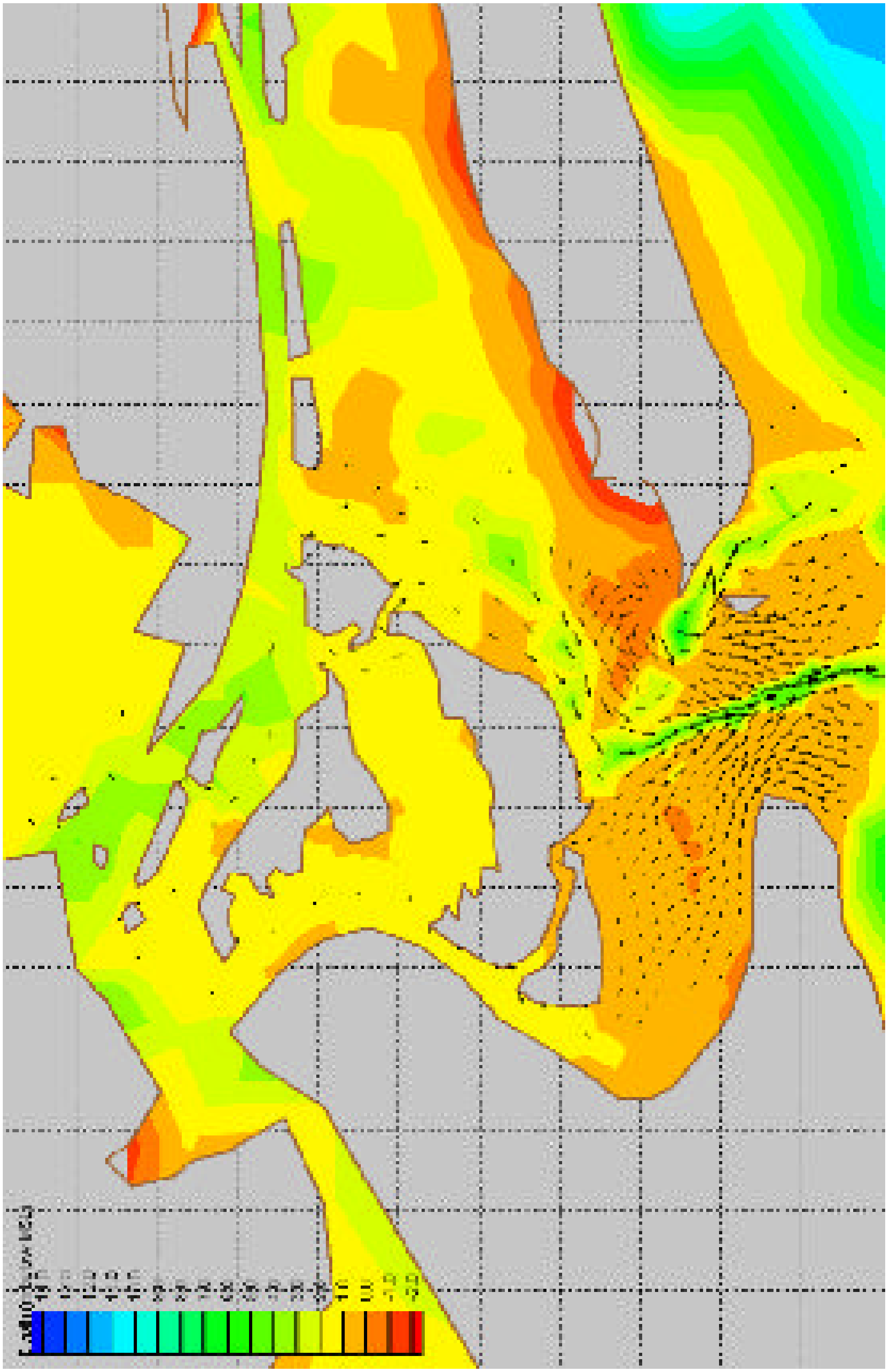
COASTAL PLANNING & ENGINEERING, INC.

2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE:

BOGUE INLET, NC, 14' MLW CHANNEL WITH CLOSURE DIKE MIDWAY THRU CONSTRUCTION PEAK FLOOD

DATE: 11/22/02	BY: TW	COMM. NO.: 4500.00	FIGURE NO. 8A



COASTAL PLANNING & ENGINEERING, INC.

2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102 FAX (561) 391-9116

TITLE :

BOGUE INLET, NC
14' MLW CHANNEL W/ CLOSURE DIKE
MIDWAY THRU CONSTRUCTION PEAK EBB

DATE:	11/22/02	BY:	TW	COMM. NO.:	4500.00	FIGURE NO. 8B

References

Coastal Science and Engineering (2001), *Analysis of Alternatives for Bogue Inlet Channel Realignment and Beach Renourishment along Western Emerald Isle, Emerald Isle, North Carolina*, Coastal Science and Engineering, LLC, Columbia, SC.

Leuttich, R.A., Westerlink, J.J., Blain, C.A., Scheffner, N.W. (1992), *ADCIRC: An Advance Three-Dimensional Circulation Model for Shelves, Coasts, and Estuaries, Reports 1 and 2,* U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS.

National Geophysical Data Center (2002a), Digital Terrain Models Available from NOAA/NGDC, January 1994, http://www.ngdc.noaa.gov/seg/fliers/se-1104.shtml.

National Geophysical Data Center (2002b), Coastline Extractor by Rich Signell, hosted by NGDC, http://rimmer.ngdc.noaa.gov/coast/getcoast.html.

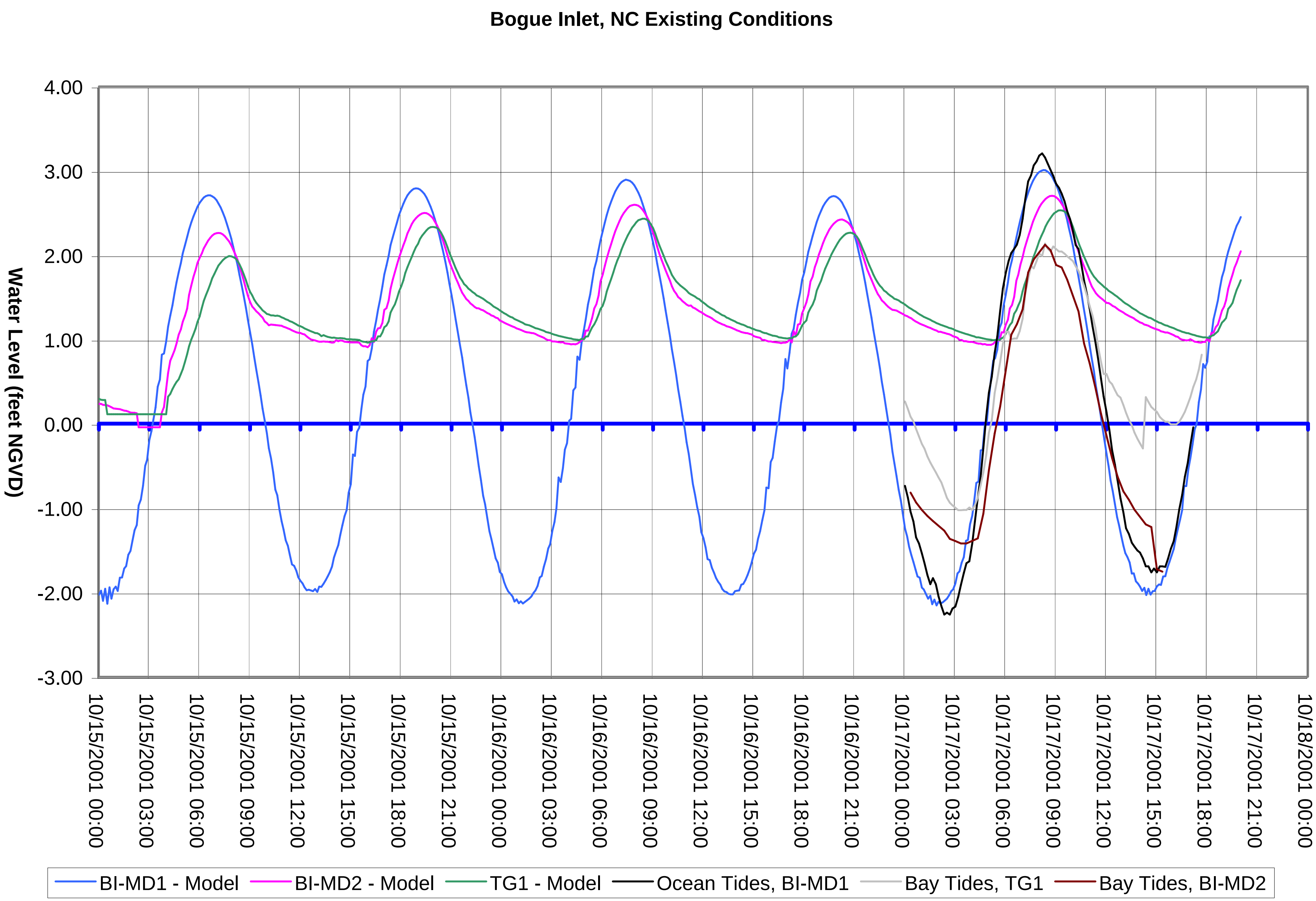
National Ocean Service (2001), Nautical Chart 11541, North Carolina, Neuse River to Myrtle Sound Grove, U.S. Department of Commerce, Washington.

U.S. Army Corps of Engineers (2002), Wilmington District, Navigation Branch Web Page, http://www.saw.usace.army.mil/nav/nav.htm.

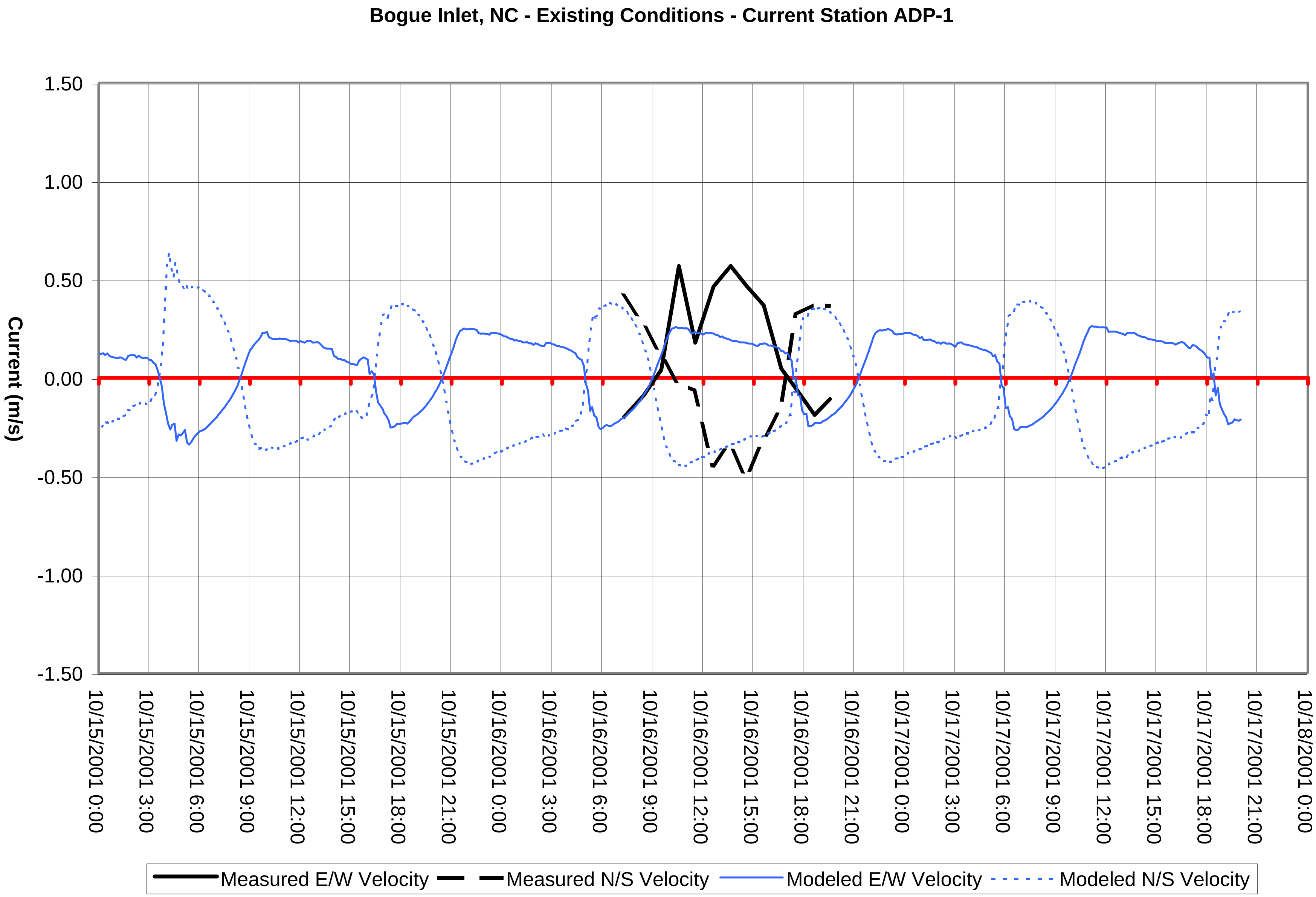
U.S. Geological Survey (2002), TerraServer, provided by USGS and Microsoft, http://terraserver.homeadvisor.msn.com/default.aspx.

APPENDIX A

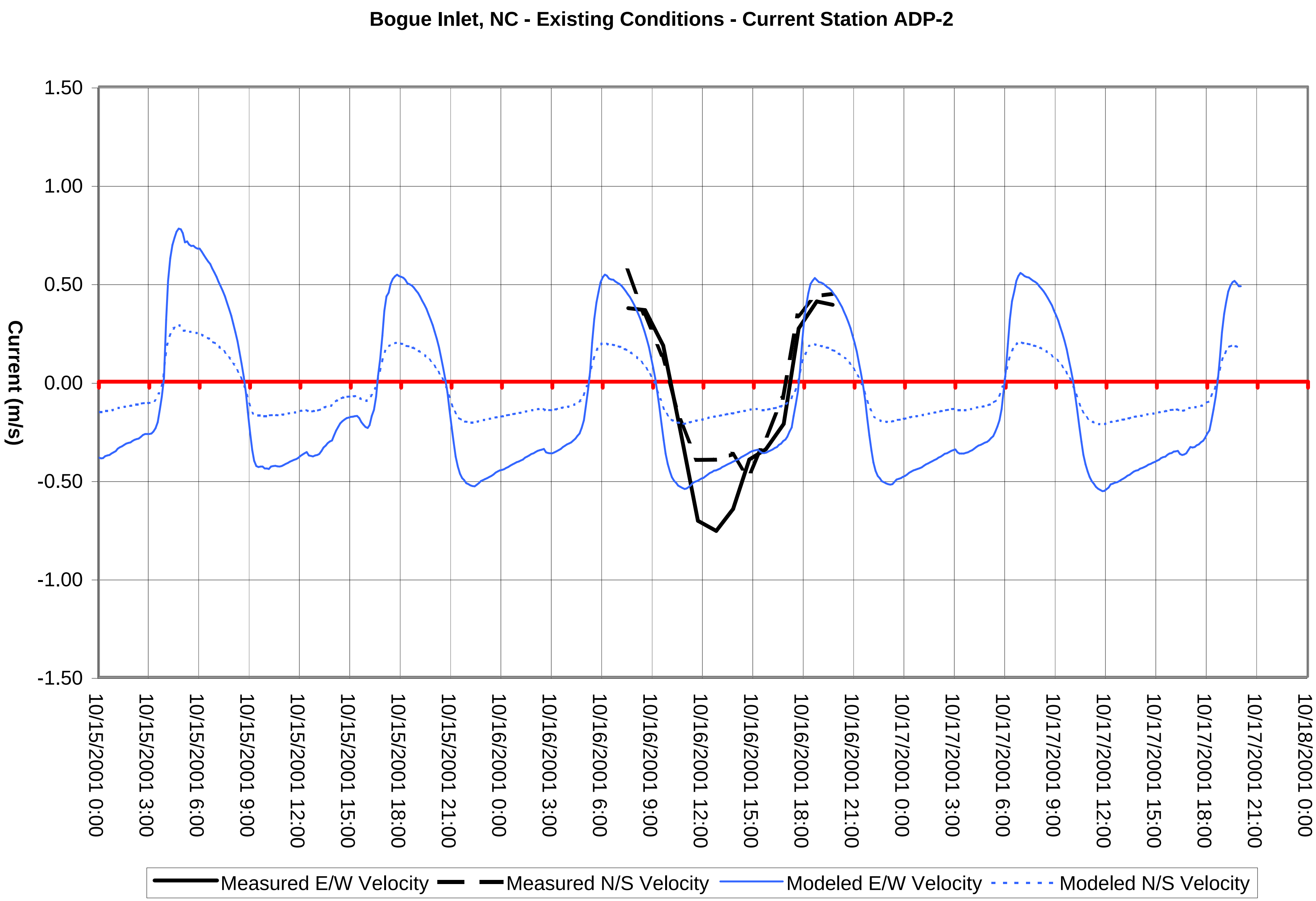
Model Calibration



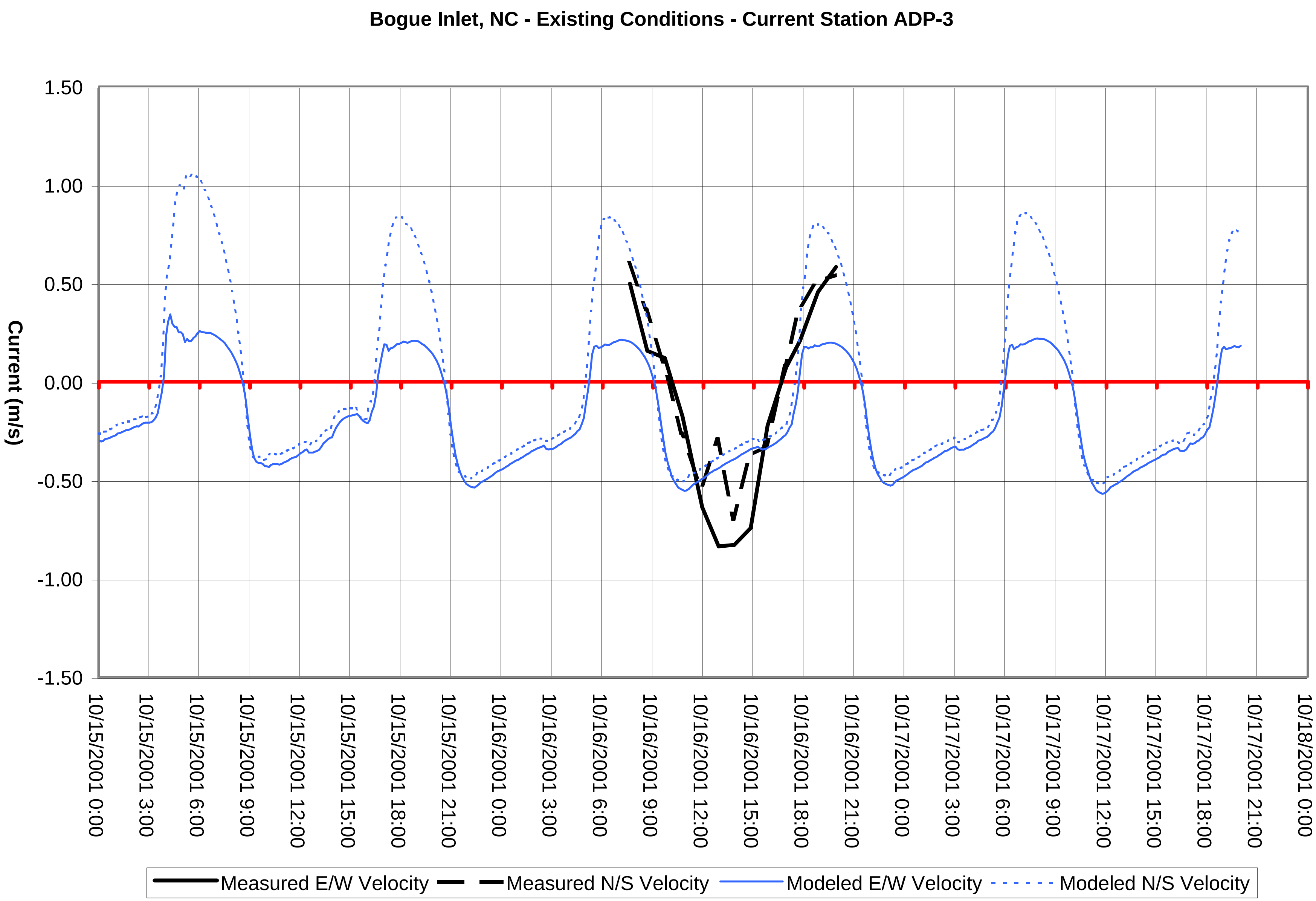
Bogue Inlet, NC Existing Conditions
Water Level (feet NGVD)
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
10/15/2001 00:00
10/15/2001 03:00
10/15/2001 06:00
10/15/2001 09:00
10/15/2001 12:00
10/15/2001 15:00
10/15/2001 18:00
10/15/2001 21:00
10/16/2001 00:00
10/16/2001 03:00
10/16/2001 06:00
10/16/2001 09:00
10/16/2001 12:00
10/16/2001 15:00
10/16/2001 18:00
10/16/2001 21:00
10/17/2001 00:00
10/17/2001 03:00
10/17/2001 06:00
10/17/2001 09:00
10/17/2001 12:00
10/17/2001 15:00
10/17/2001 18:00
10/17/2001 21:00
10/18/2001 00:00
BI-MD1 - Model
BI-MD2 - Model
TG1 - Model
Ocean Tides, BI-MD1
Bay Tides, TG1
Bay Tides, BI-MD2

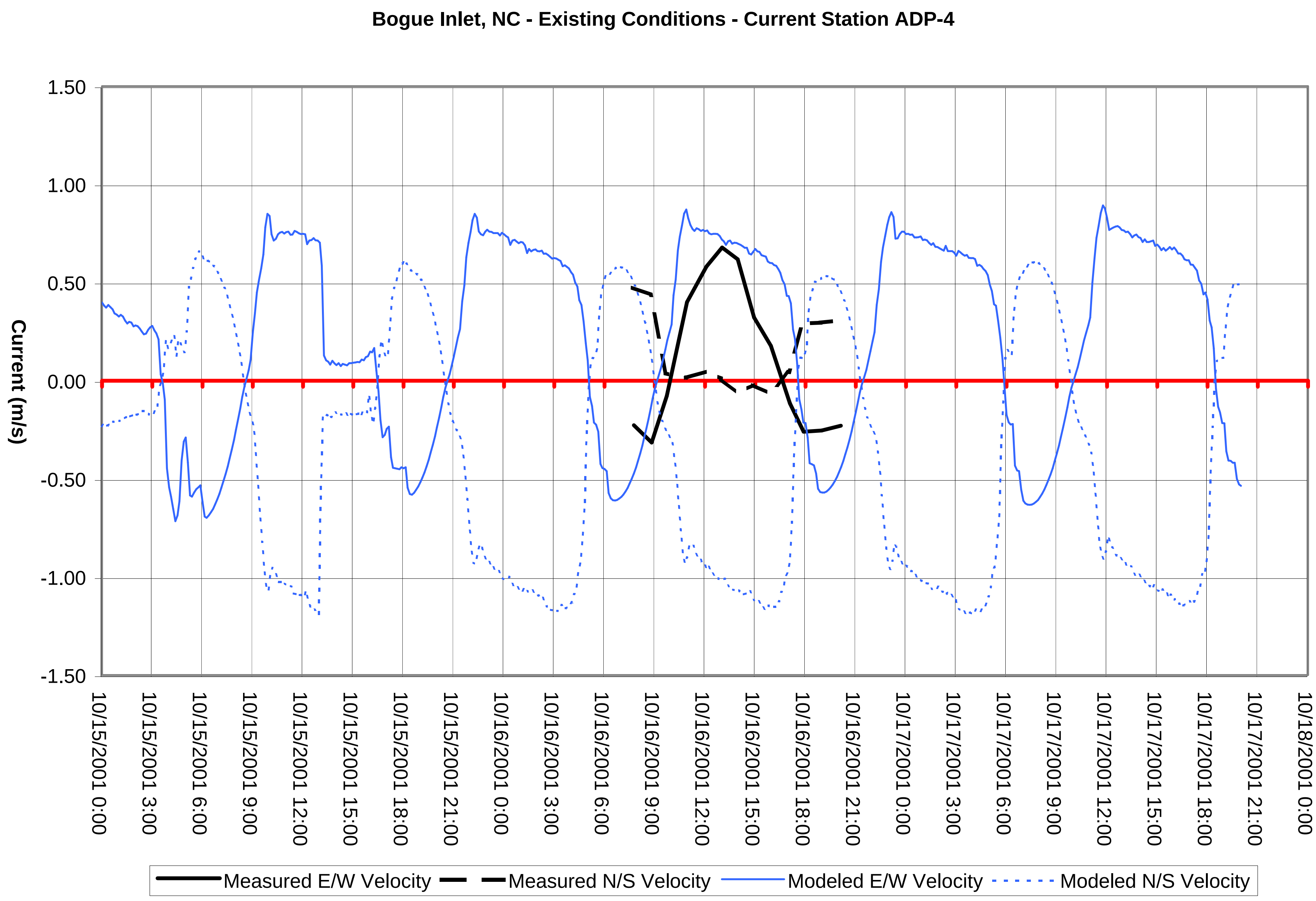


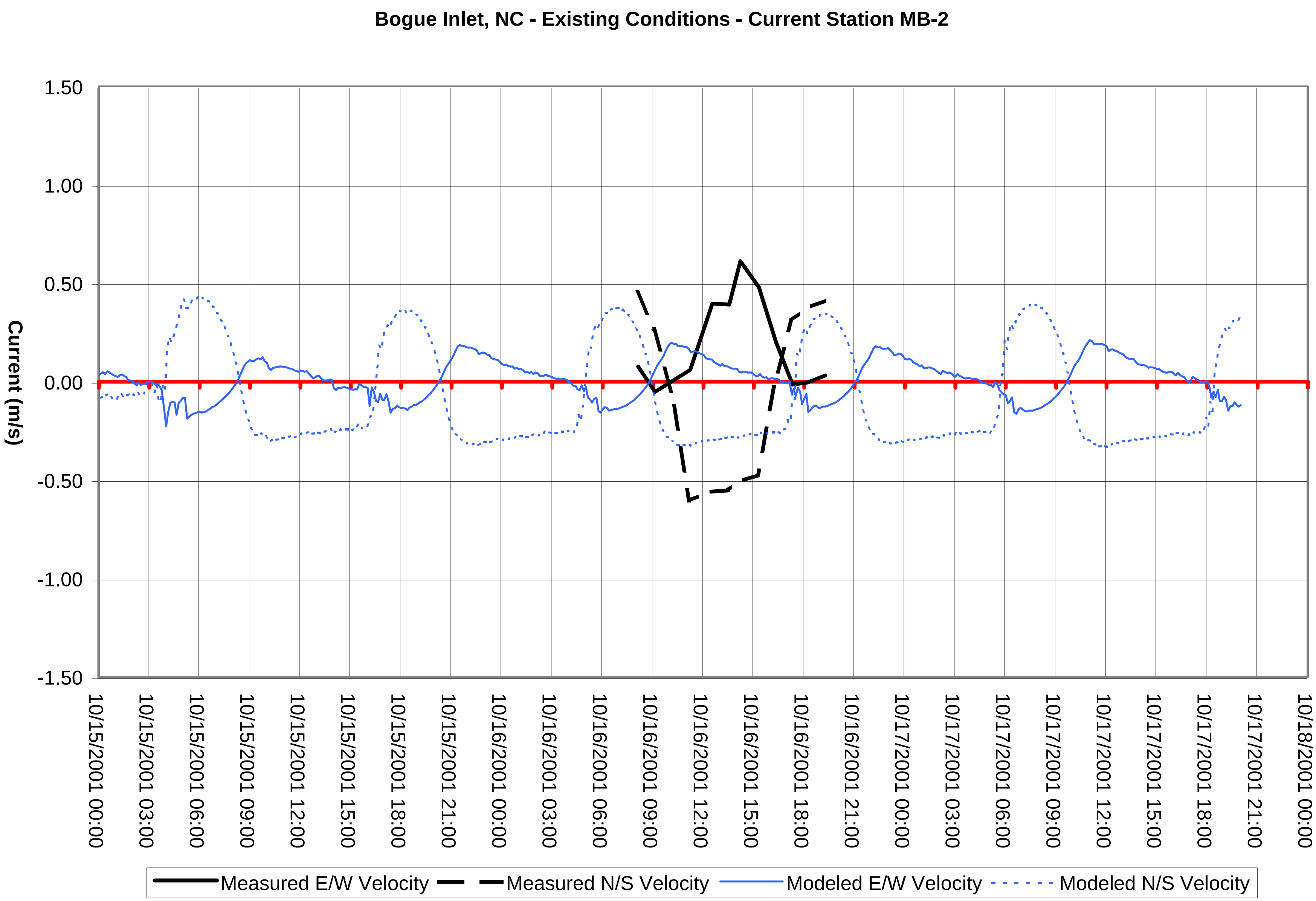
Bogue Inlet, NC - Existing Conditions - Current Station ADP-1
Current (m/s)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
10/15/2001 0:00
10/15/2001 3:00
10/15/2001 6:00
10/15/2001 9:00
10/15/2001 12:00
10/15/2001 15:00
10/15/2001 18:00
10/15/2001 21:00
10/16/2001 0:00
10/16/2001 3:00
10/16/2001 6:00
10/16/2001 9:00
10/16/2001 12:00
10/16/2001 15:00
10/16/2001 18:00
10/16/2001 21:00
10/17/2001 0:00
10/17/2001 3:00
10/17/2001 6:00
10/17/2001 9:00
10/17/2001 12:00
10/17/2001 15:00
10/17/2001 18:00
10/17/2001 21:00
10/18/2001 0:00
Measured E/W Velocity
Measured N/S Velocity
Modeled E/W Velocity
Modeled N/S Velocity

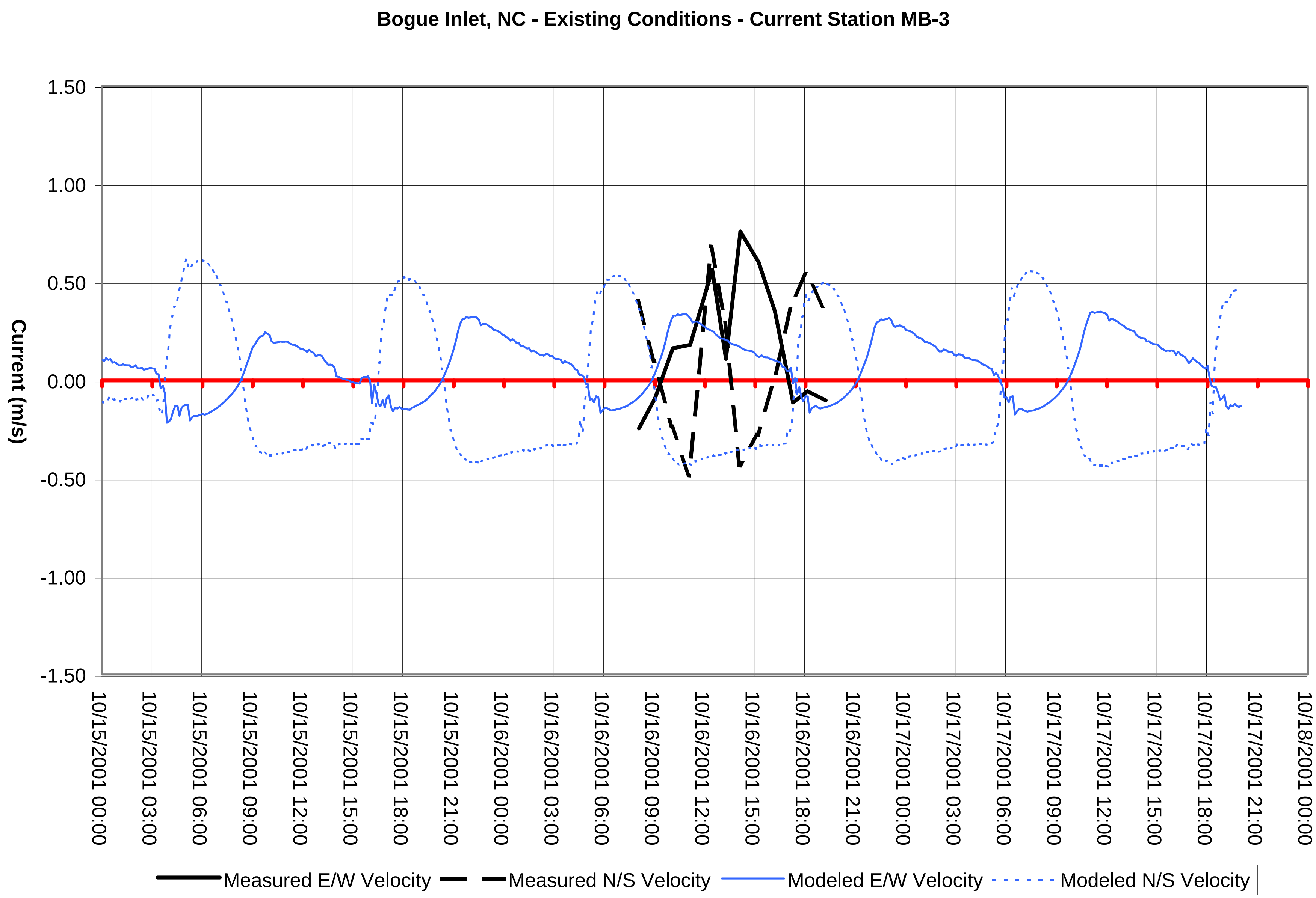


Bogue Inlet, NC - Existing Conditions - Current Station ADP-2
Current (m/s)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
10/15/2001 0:00
10/15/2001 3:00
10/15/2001 6:00
10/15/2001 9:00
10/15/2001 12:00
10/15/2001 15:00
10/15/2001 18:00
10/15/2001 21:00
10/16/2001 0:00
10/16/2001 3:00
10/16/2001 6:00
10/16/2001 9:00
10/16/2001 12:00
10/16/2001 15:00
10/16/2001 18:00
10/16/2001 21:00
10/17/2001 0:00
10/17/2001 3:00
10/17/2001 6:00
10/17/2001 9:00
10/17/2001 12:00
10/17/2001 15:00
10/17/2001 18:00
10/17/2001 21:00
10/18/2001 0:00
Measured E/W Velocity
Measured N/S Velocity
Modeled E/W Velocity
Modeled N/S Velocity

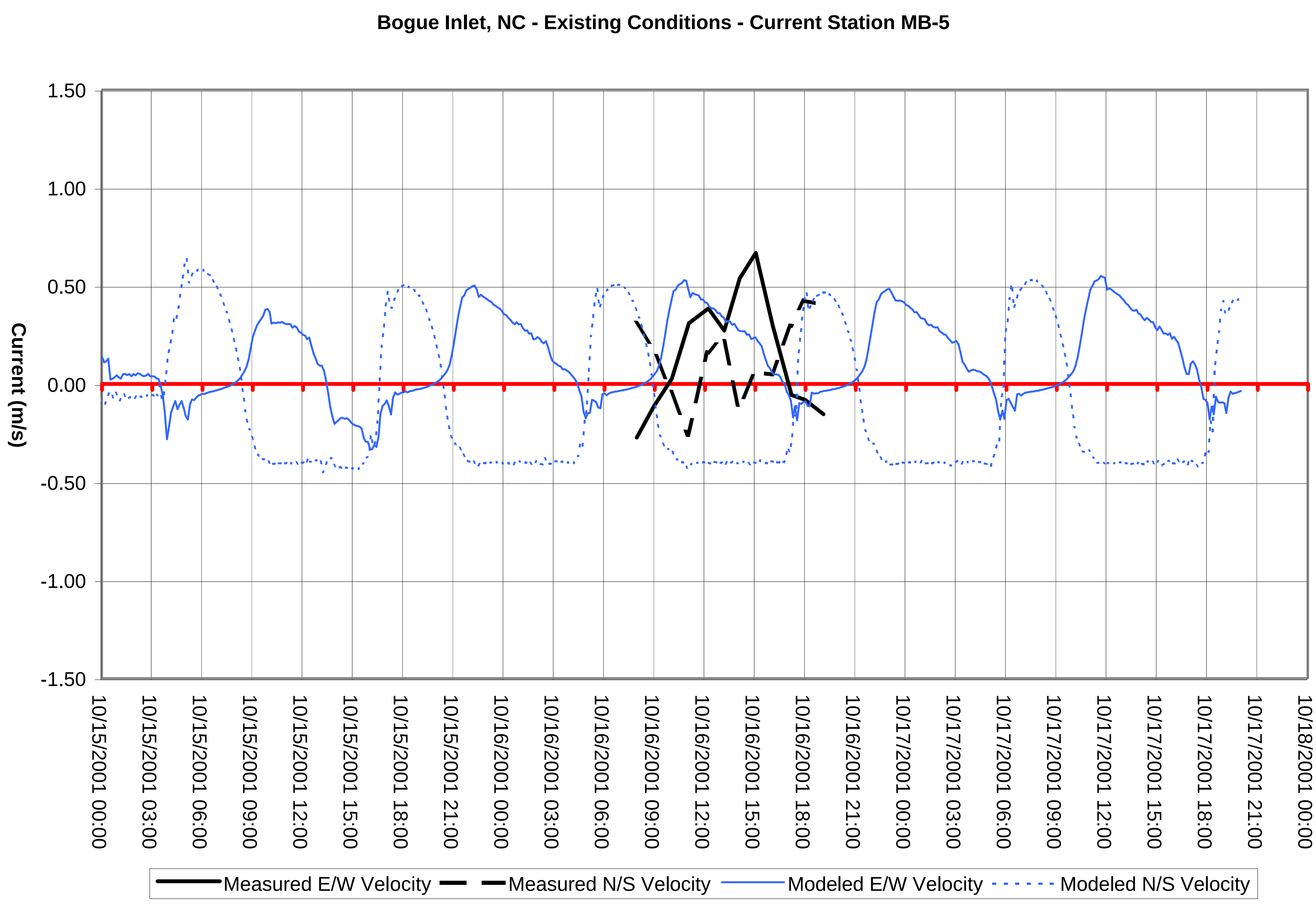

Bogue Inlet, NC - Existing Conditions - Current Station ADP-3
Current (m/s)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
10/15/2001 0:00
10/15/2001 3:00
10/15/2001 6:00
10/15/2001 9:00
10/15/2001 12:00
10/15/2001 15:00
10/15/2001 18:00
10/15/2001 21:00
10/16/2001 0:00
10/16/2001 3:00
10/16/2001 6:00
10/16/2001 9:00
10/16/2001 12:00
10/16/2001 15:00
10/16/2001 18:00
10/16/2001 21:00
10/17/2001 0:00
10/17/2001 3:00
10/17/2001 6:00
10/17/2001 9:00
10/17/2001 12:00
10/17/2001 15:00
10/17/2001 18:00
10/17/2001 21:00
10/18/2001 0:00
Measured E/W Velocity
Measured N/S Velocity
Modeled E/W Velocity
Modeled N/S Velocity


Bogue Inlet, NC - Existing Conditions - Current Station ADP-4
Current (m/s)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
10/15/2001 0:00
10/15/2001 3:00
10/15/2001 6:00
10/15/2001 9:00
10/15/2001 12:00
10/15/2001 15:00
10/15/2001 18:00
10/15/2001 21:00
10/16/2001 0:00
10/16/2001 3:00
10/16/2001 6:00
10/16/2001 9:00
10/16/2001 12:00
10/16/2001 15:00
10/16/2001 18:00
10/16/2001 21:00
10/17/2001 0:00
10/17/2001 3:00
10/17/2001 6:00
10/17/2001 9:00
10/17/2001 12:00
10/17/2001 15:00
10/17/2001 18:00
10/17/2001 21:00
10/18/2001 0:00
Measured E/W Velocity
Measured N/S Velocity
Modeled E/W Velocity
Modeled N/S Velocity

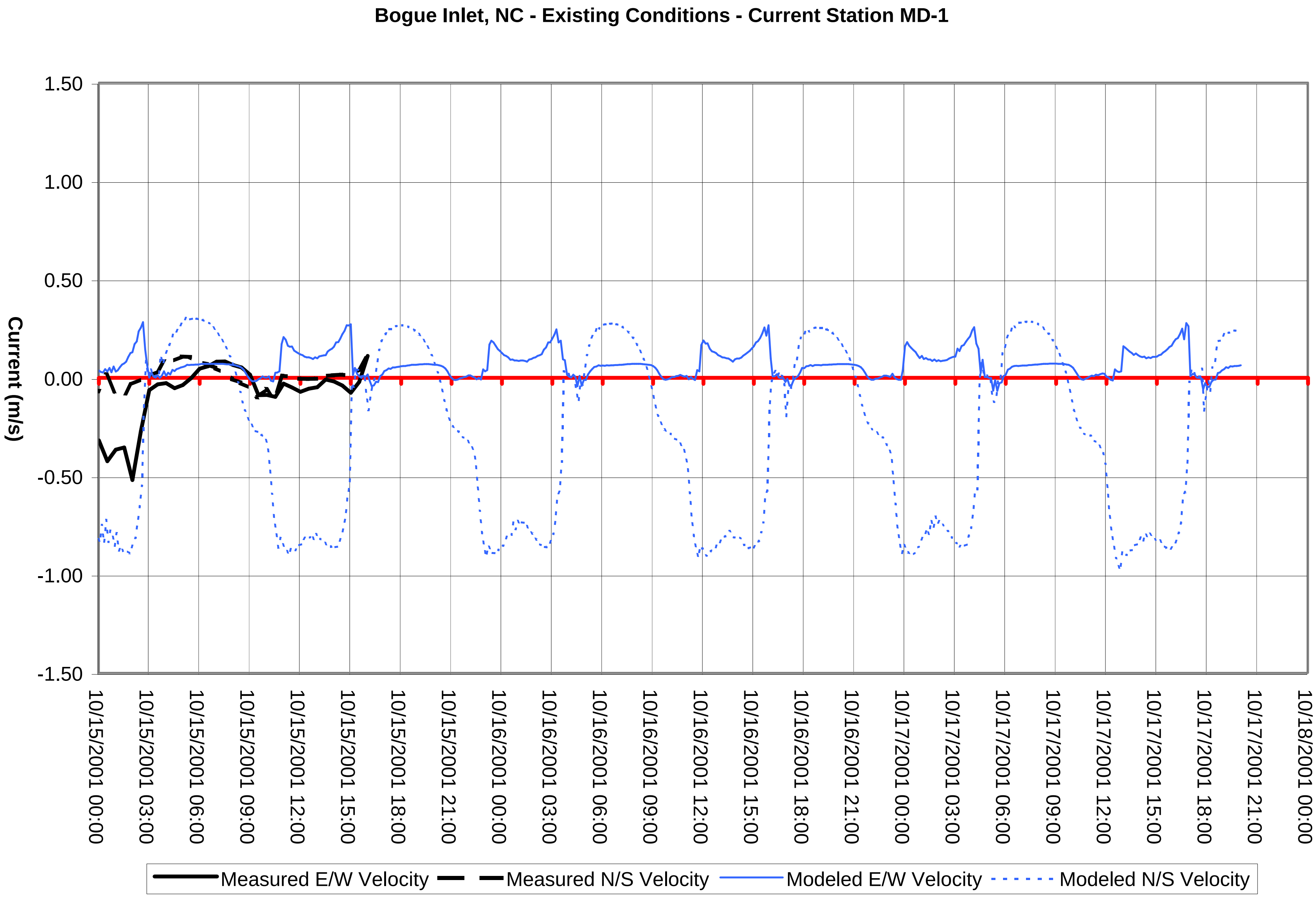

Bogue Inlet, NC - Existing Conditions - Current Station MB-2
Current (m/s)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
10/15/2001 00:00
10/15/2001 03:00
10/15/2001 06:00
10/15/2001 09:00
10/15/2001 12:00
10/15/2001 15:00
10/15/2001 18:00
10/15/2001 21:00
10/16/2001 00:00
10/16/2001 03:00
10/16/2001 06:00
10/16/2001 09:00
10/16/2001 12:00
10/16/2001 15:00
10/16/2001 18:00
10/16/2001 21:00
10/17/2001 00:00
10/17/2001 03:00
10/17/2001 06:00
10/17/2001 09:00
10/17/2001 12:00
10/17/2001 15:00
10/17/2001 18:00
10/17/2001 21:00
10/18/2001 00:00
Measured E/W Velocity
Measured N/S Velocity
Modeled E/W Velocity
Modeled N/S Velocity

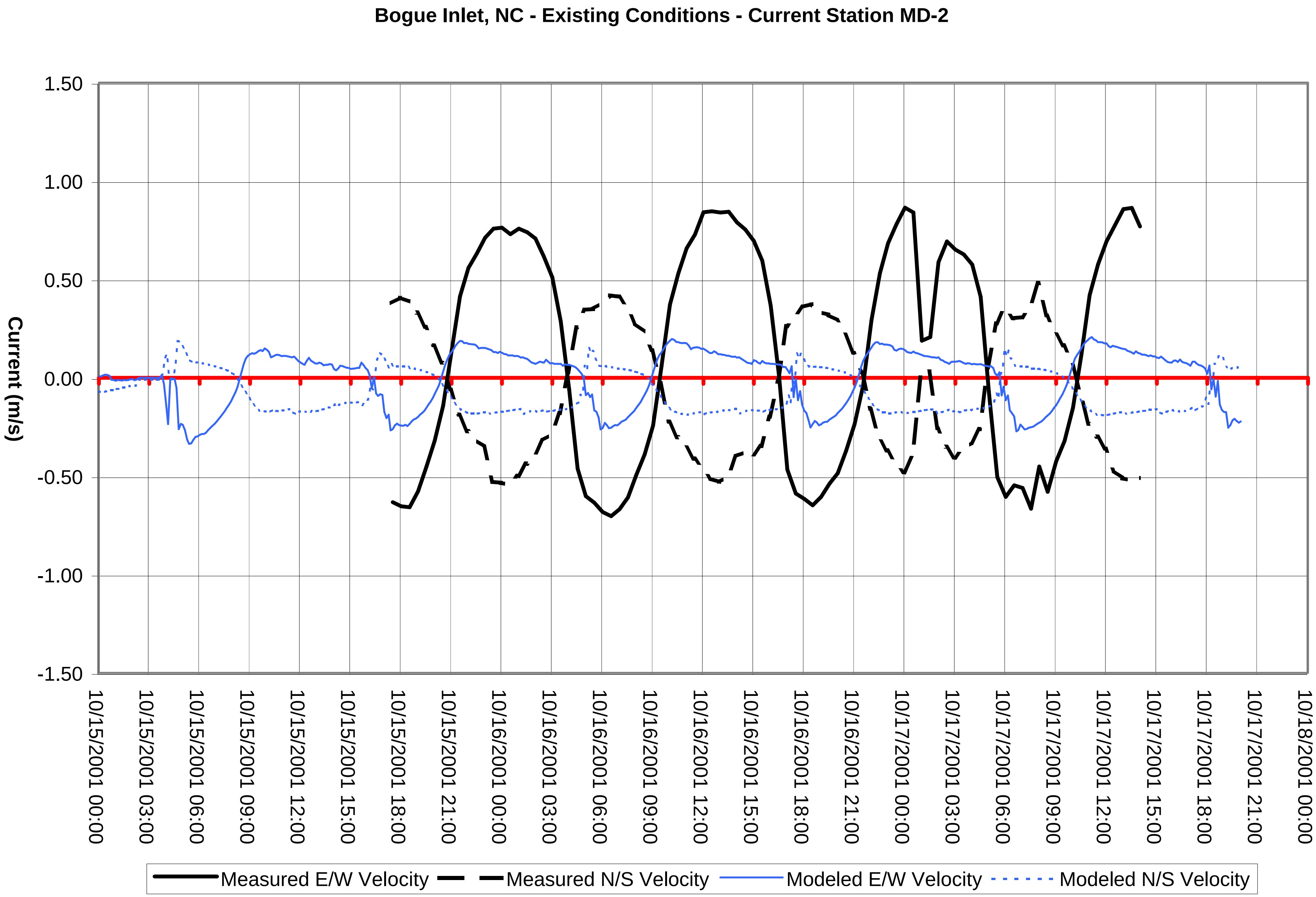


Bogue Inlet, NC - Existing Conditions - Current Station MB-3
Current (m/s)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
10/15/2001 00:00
10/15/2001 03:00
10/15/2001 06:00
10/15/2001 09:00
10/15/2001 12:00
10/15/2001 15:00
10/15/2001 18:00
10/15/2001 21:00
10/16/2001 00:00
10/16/2001 03:00
10/16/2001 06:00
10/16/2001 09:00
10/16/2001 12:00
10/16/2001 15:00
10/16/2001 18:00
10/16/2001 21:00
10/17/2001 00:00
10/17/2001 03:00
10/17/2001 06:00
10/17/2001 09:00
10/17/2001 12:00
10/17/2001 15:00
10/17/2001 18:00
10/17/2001 21:00
10/18/2001 00:00
Measured E/W Velocity
Measured N/S Velocity
Modeled E/W Velocity
Modeled N/S Velocity



Bogue Inlet, NC - Existing Conditions - Current Station MB-5
Current (m/s)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
10/15/2001 00:00
10/15/2001 03:00
10/15/2001 06:00
10/15/2001 09:00
10/15/2001 12:00
10/15/2001 15:00
10/15/2001 18:00
10/15/2001 21:00
10/16/2001 00:00
10/16/2001 03:00
10/16/2001 06:00
10/16/2001 09:00
10/16/2001 12:00
10/16/2001 15:00
10/16/2001 18:00
10/16/2001 21:00
10/17/2001 00:00
10/17/2001 03:00
10/17/2001 06:00
10/17/2001 09:00
10/17/2001 12:00
10/17/2001 15:00
10/17/2001 18:00
10/17/2001 21:00
10/18/2001 00:00
Measured E/W Velocity
Measured N/S Velocity
Modeled E/W Velocity
Modeled N/S Velocity


Bogue Inlet, NC - Existing Conditions - Current Station MD-1
Current (m/s)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
10/15/2001 00:00
10/15/2001 03:00
10/15/2001 06:00
10/15/2001 09:00
10/15/2001 12:00
10/15/2001 15:00
10/15/2001 18:00
10/15/2001 21:00
10/16/2001 00:00
10/16/2001 03:00
10/16/2001 06:00
10/16/2001 09:00
10/16/2001 12:00
10/16/2001 15:00
10/16/2001 18:00
10/16/2001 21:00
10/17/2001 00:00
10/17/2001 03:00
10/17/2001 06:00
10/17/2001 09:00
10/17/2001 12:00
10/17/2001 15:00
10/17/2001 18:00
10/17/2001 21:00
10/18/2001 00:00
Measured E/W Velocity
Measured N/S Velocity
Modeled E/W Velocity
Modeled N/S Velocity


Bogue Inlet, NC - Existing Conditions - Current Station MD-2
Current (m/s)
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
10/15/2001 00:00
10/15/2001 03:00
10/15/2001 06:00
10/15/2001 09:00
10/15/2001 12:00
10/15/2001 15:00
10/15/2001 18:00
10/15/2001 21:00
10/16/2001 00:00
10/16/2001 03:00
10/16/2001 06:00
10/16/2001 09:00
10/16/2001 12:00
10/16/2001 15:00
10/16/2001 18:00
10/16/2001 21:00
10/17/2001 00:00
10/17/2001 03:00
10/17/2001 06:00
10/17/2001 09:00
10/17/2001 12:00
10/17/2001 15:00
10/17/2001 18:00
10/17/2001 21:00
10/18/2001 00:00
Measured E/W Velocity
Measured N/S Velocity
Modeled E/W Velocity
Modeled N/S Velocity

APPENDIX B

Velocity and Discharge Comparisons

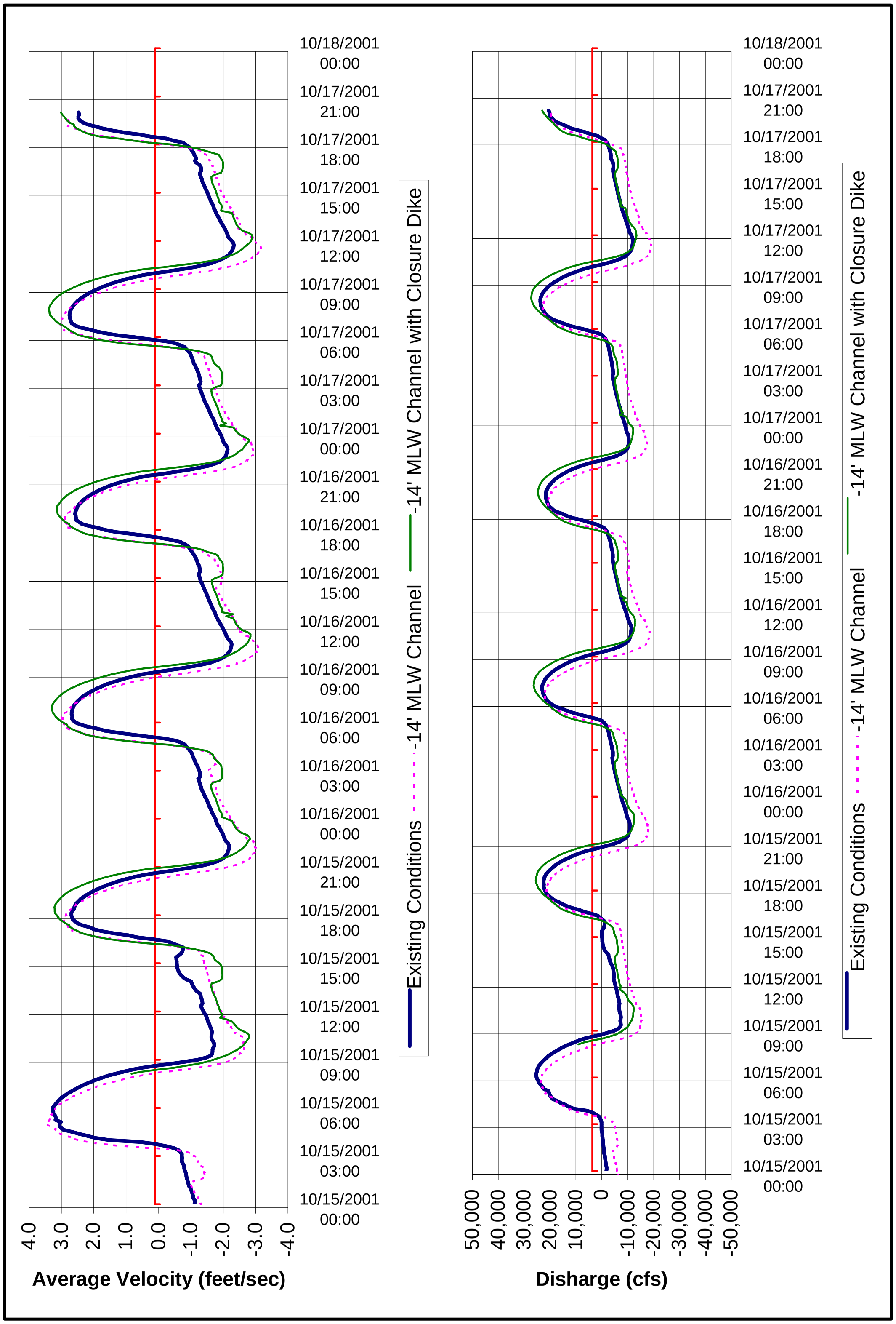


FIGURE B1

BOGUE INLET, NC FLOW COMPARISON - SECTION 2

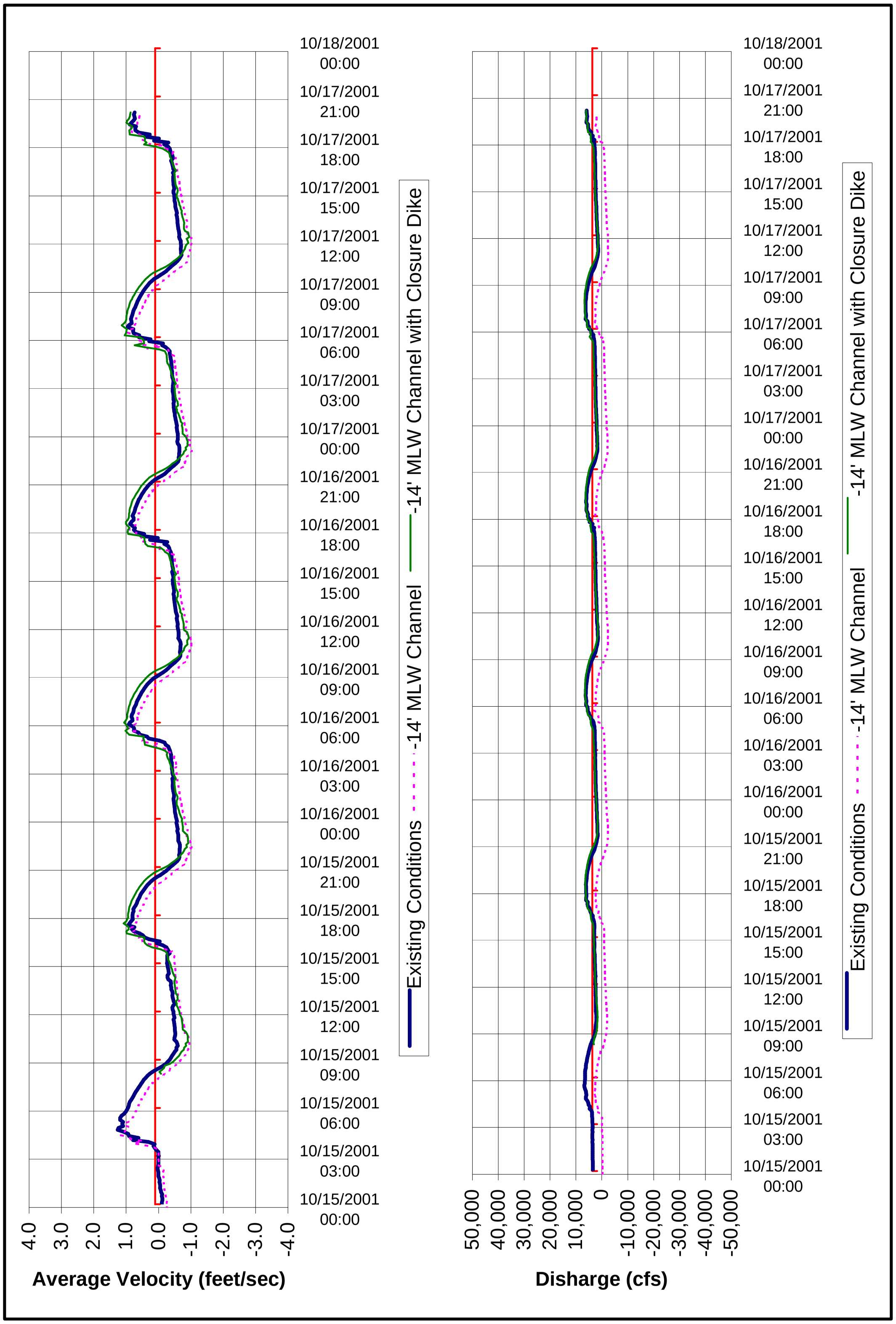


FIGURE B2

BOGUE INLET, NC FLOW COMPARISON - SECTION 3A

BOGUE INLET, NC FLOW COMPARISON - SECTION 3B

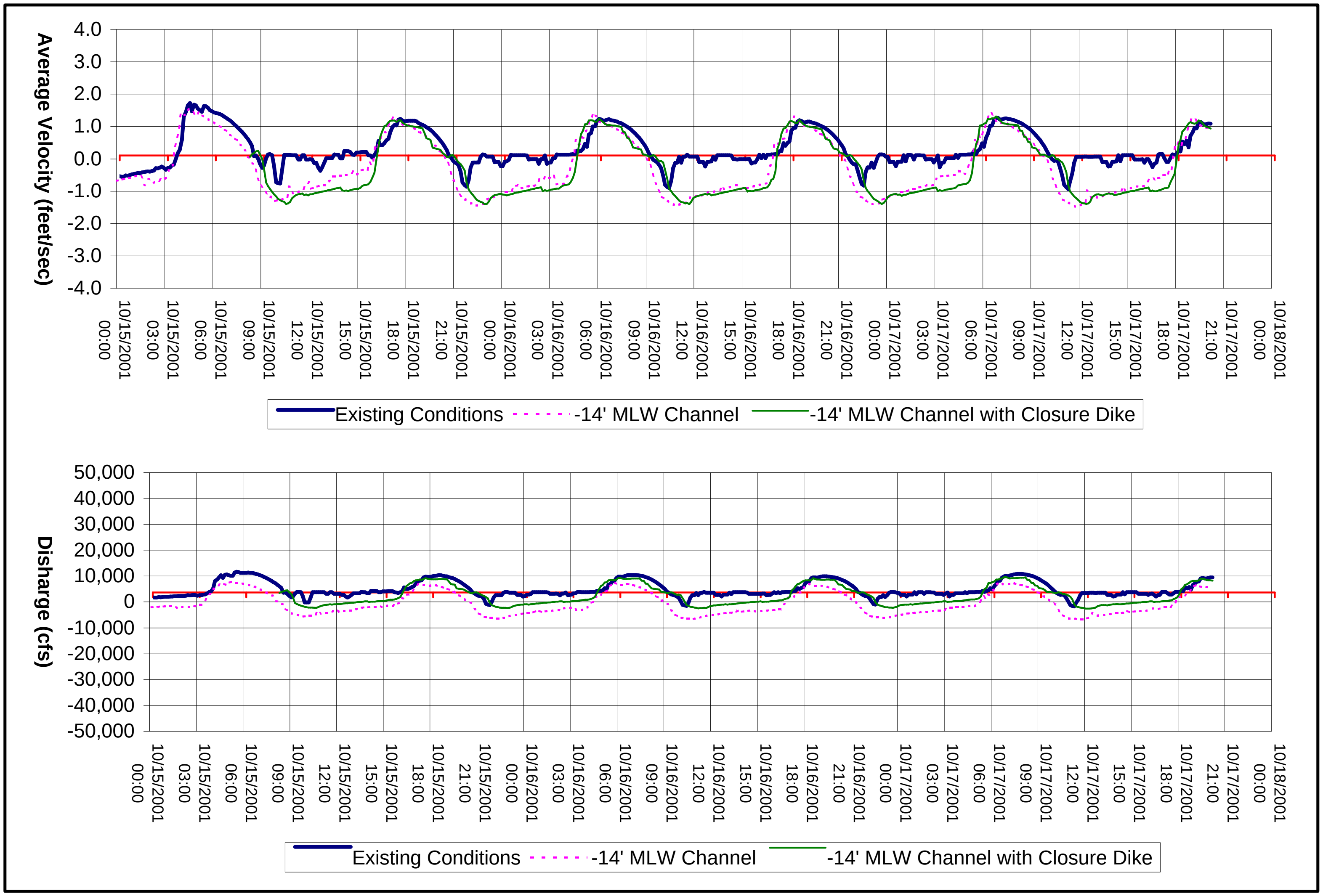


FIGURE B3

COASTAL PLANNING & ENGINEERING, INC.

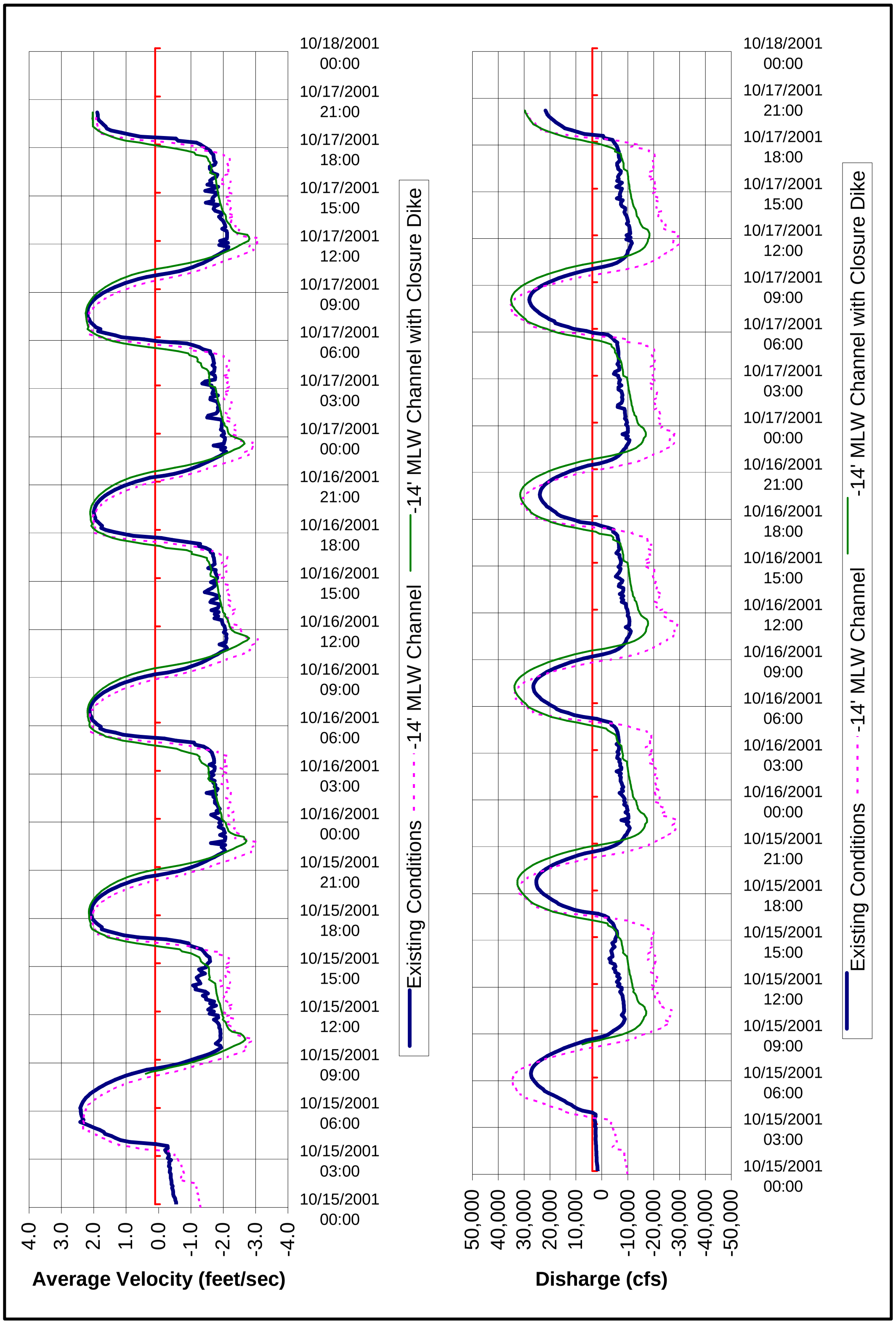
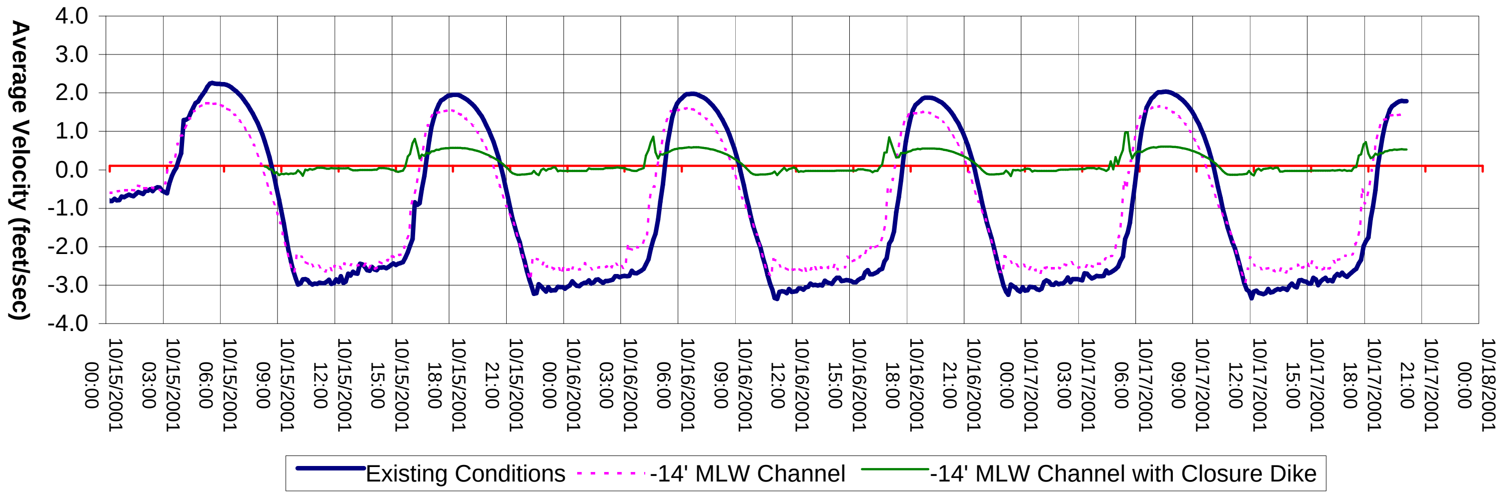


FIGURE B4

BOGUE INLET, NC FLOW COMPARISON - SECTION 4

BOGUE INLET, NC FLOW COMPARISON - SECTION 6



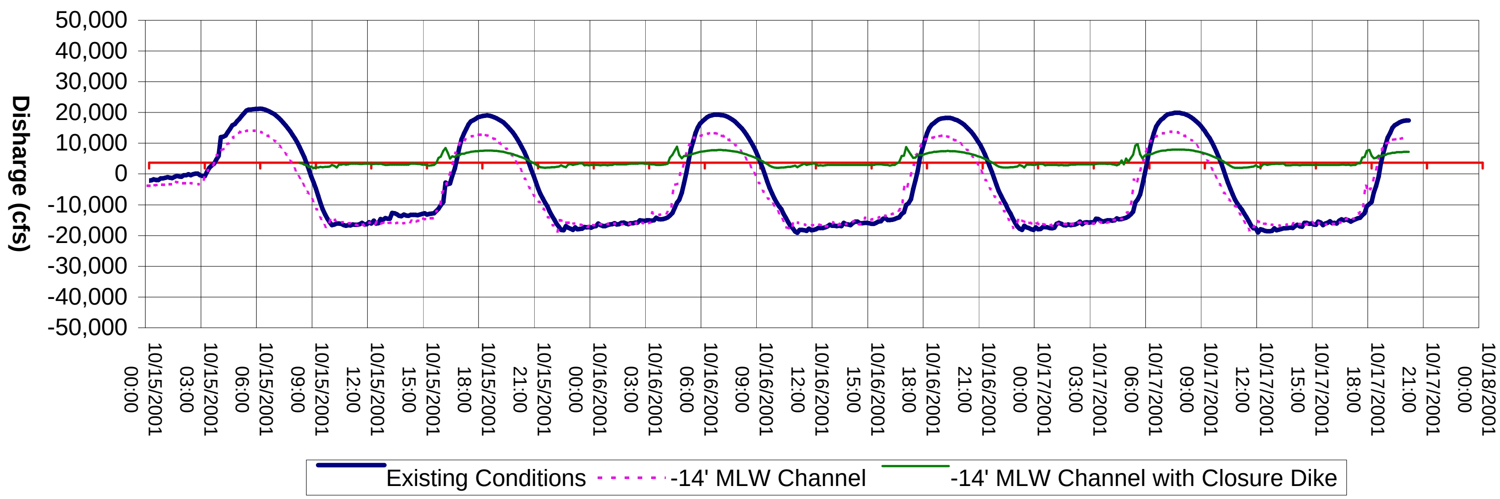


FIGURE B5

COASTAL PLANNING & ENGINEERING, INC.

BOGUE INLET, NC FLOW COMPARISON - SECTION 6

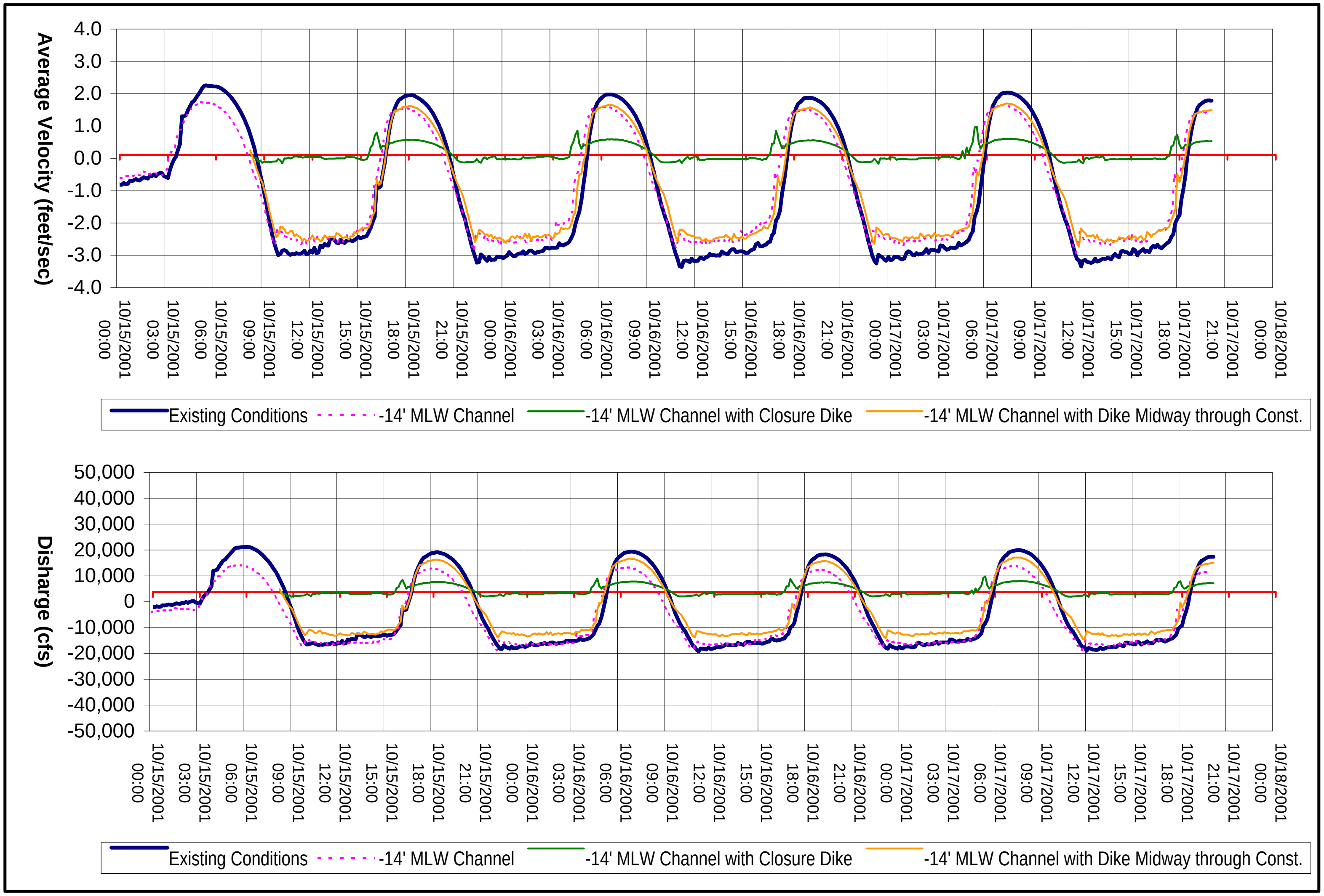


FIGURE B5

COASTAL PLANNING & ENGINEERING, INC.

BOGUE INLET, NC FLOW COMPARISON - SECTION 7

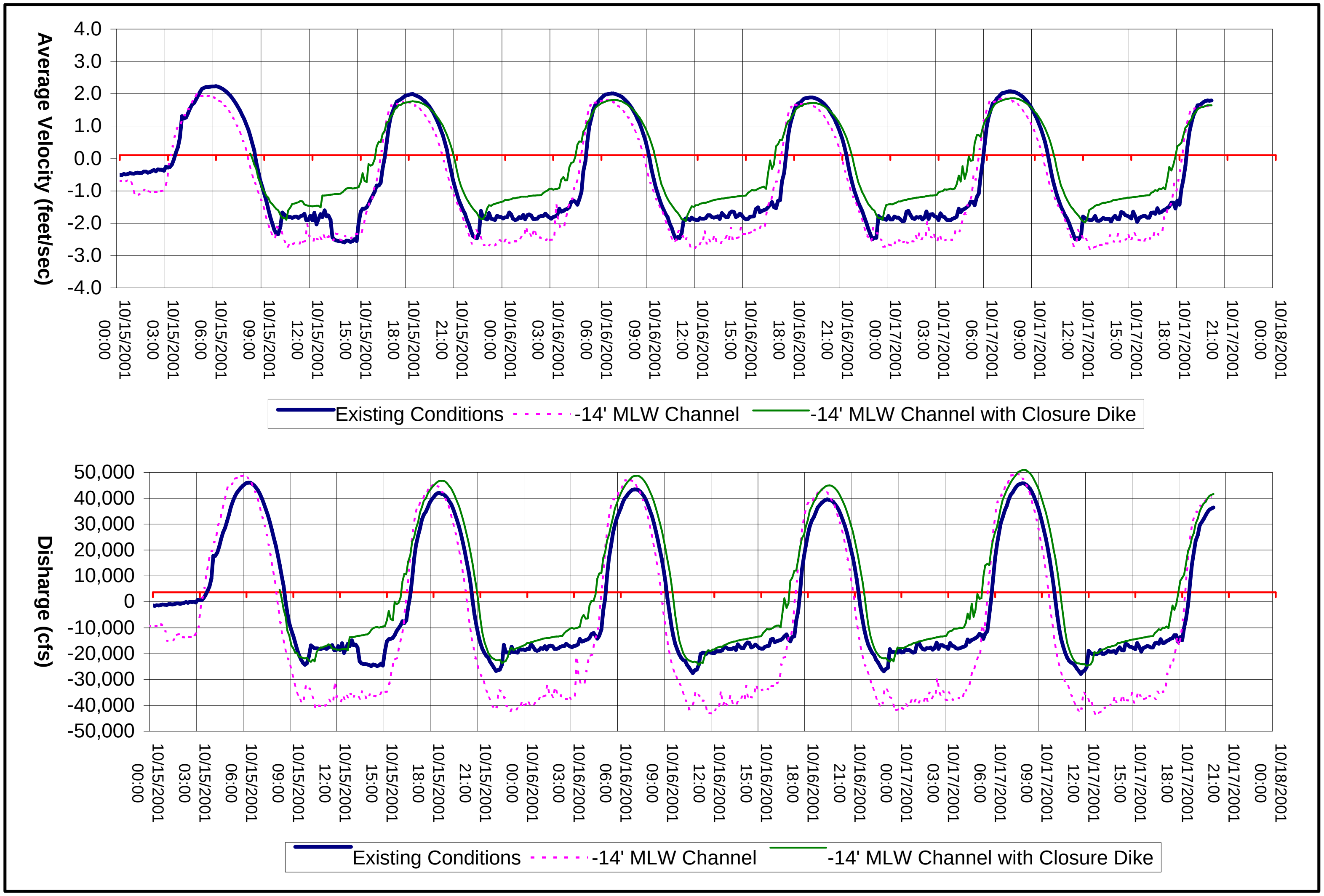
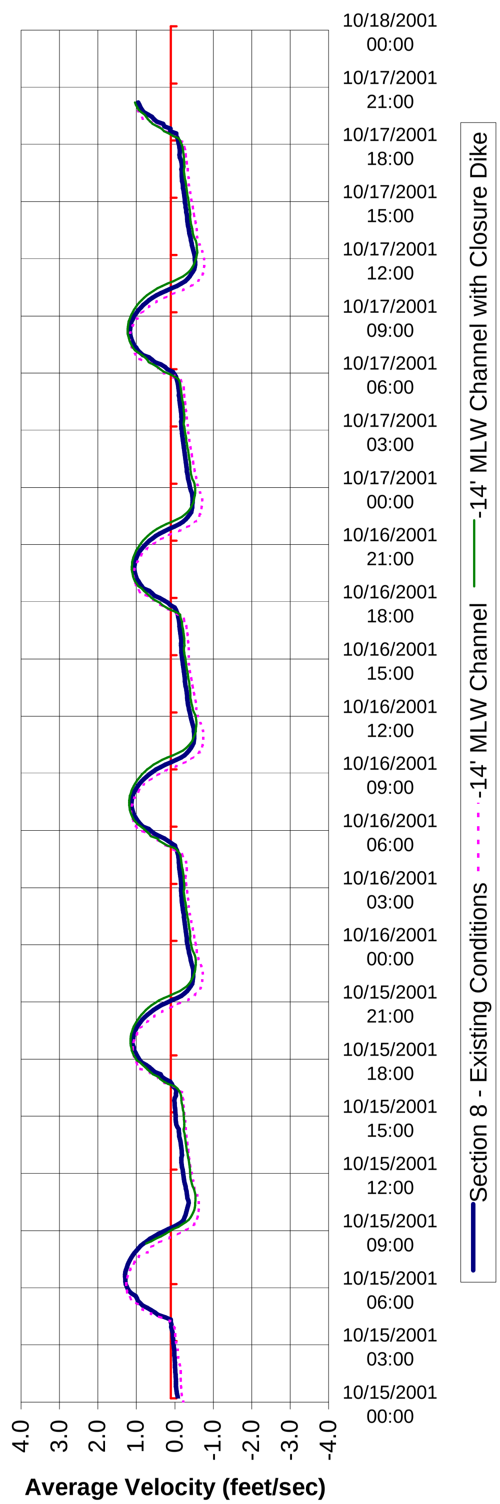


FIGURE B6

COASTAL PLANNING & ENGINEERING, INC.



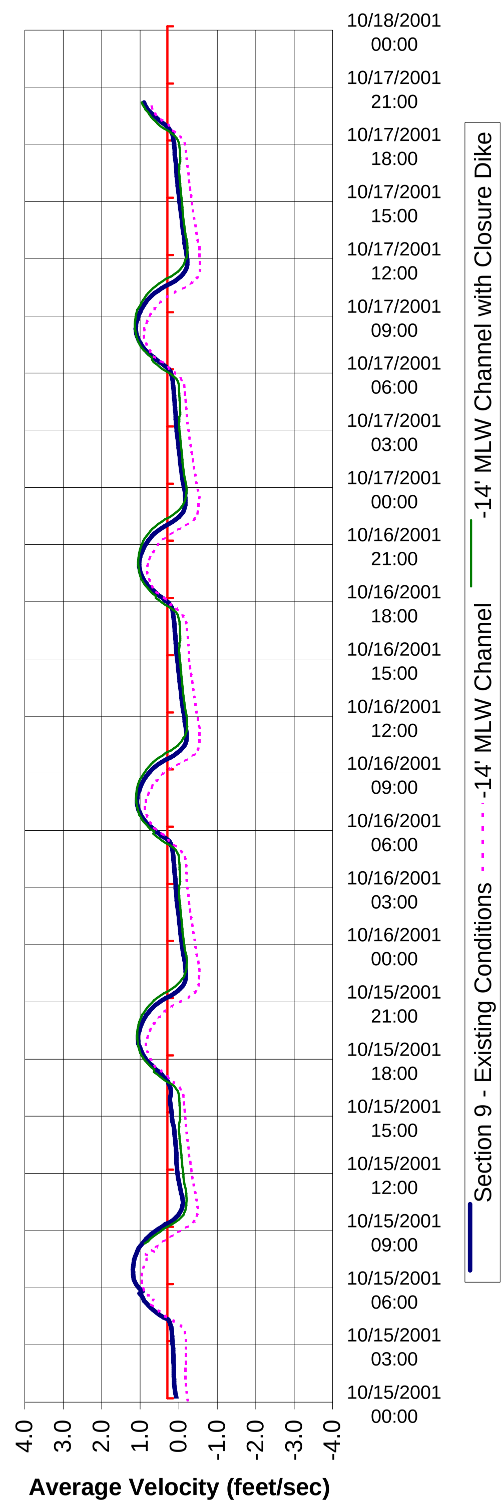
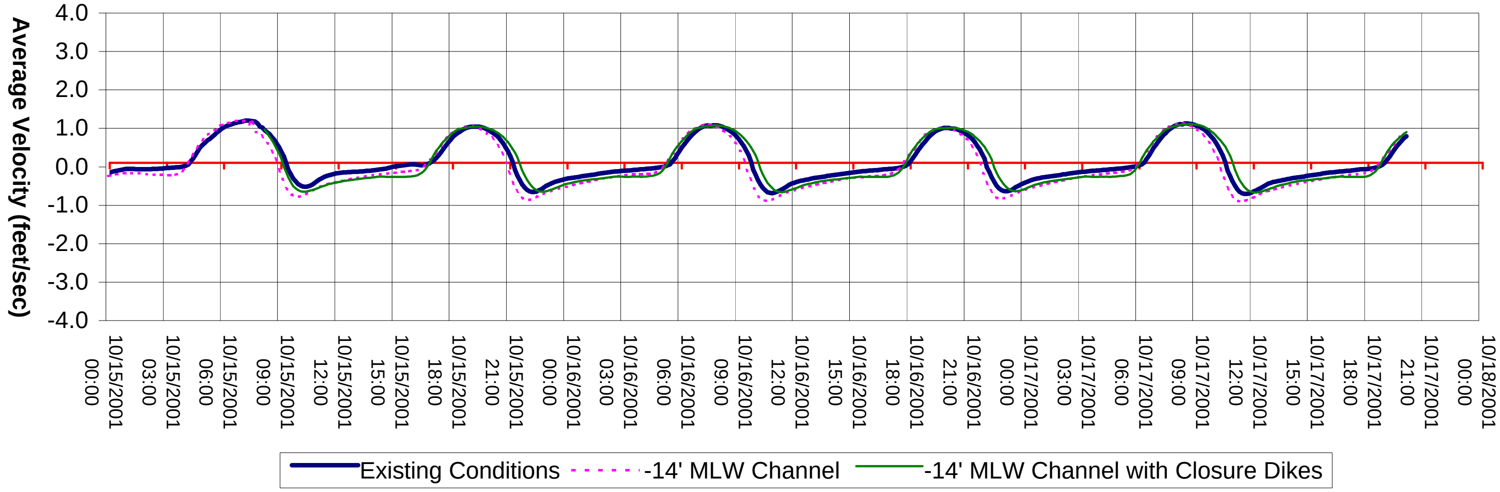


FIGURE B8

BOGUE INLET, NC FLOW COMPARISON - SECTIONS 8 & 9

O:\North Carolina\Emerald Isle 4500.00_03\bathymetry\FINAL_RUNS\APPXB_FLOW_COMPARISONS.XLS plot10

BOGUE INLET, NC FLOW COMPARISON - SECTION 10



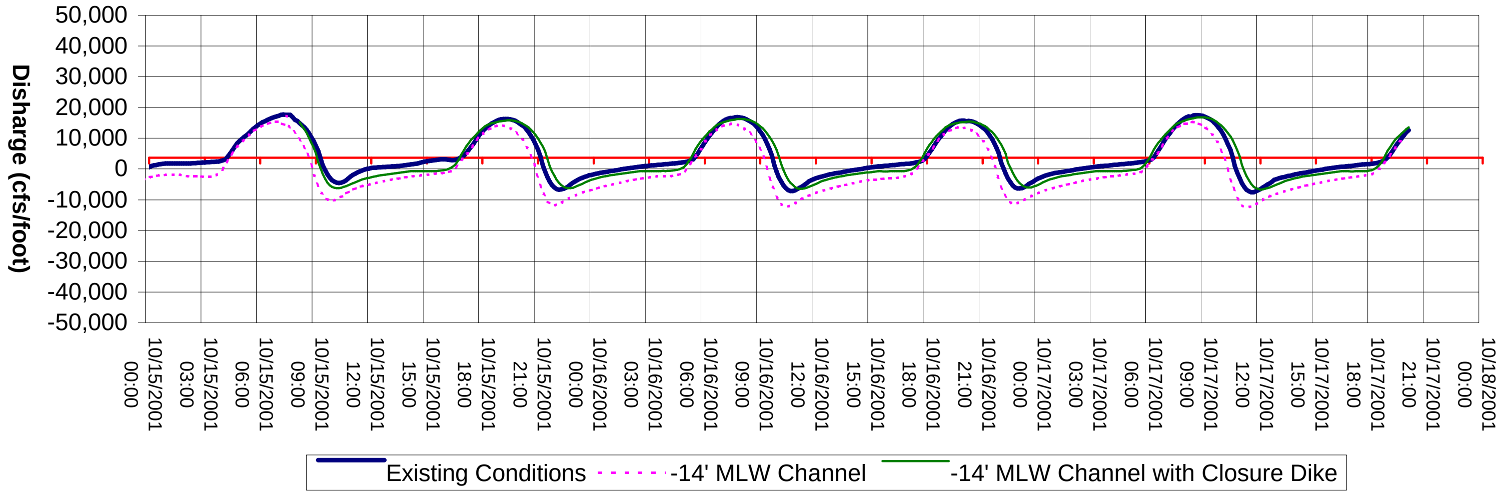


FIGURE B9

COASTAL PLANNING & ENGINEERING, INC.

O:\North Carolina\Emerald Isle 4500.00_03\bathymetry\FINAL_RUNS\APPXB_FLOW_COMPARISONS.XLS plot11

BOGUE INLET, NC FLOW COMPARISON - SECTION 11

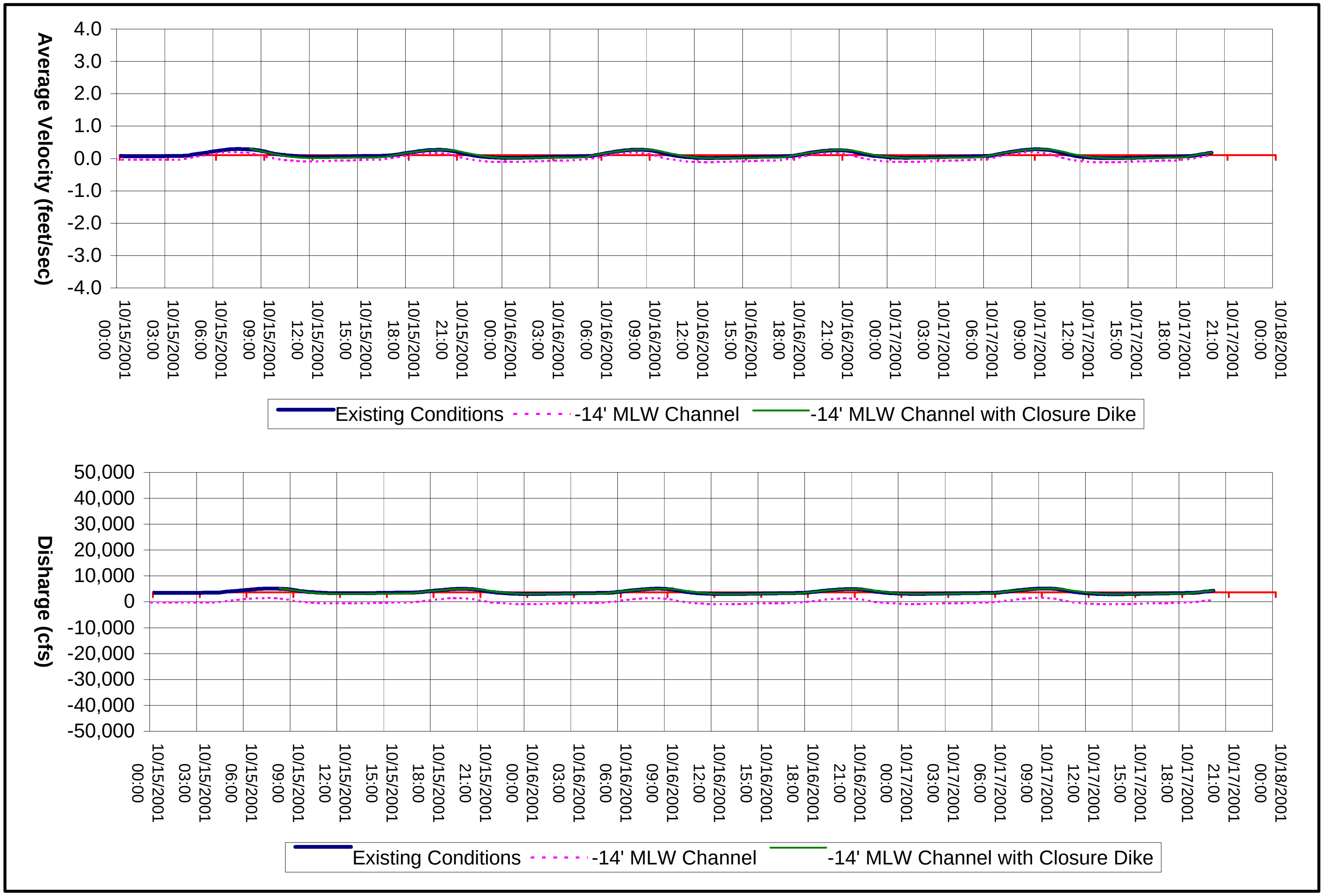


FIGURE B10

COASTAL PLANNING & ENGINEERING, INC.